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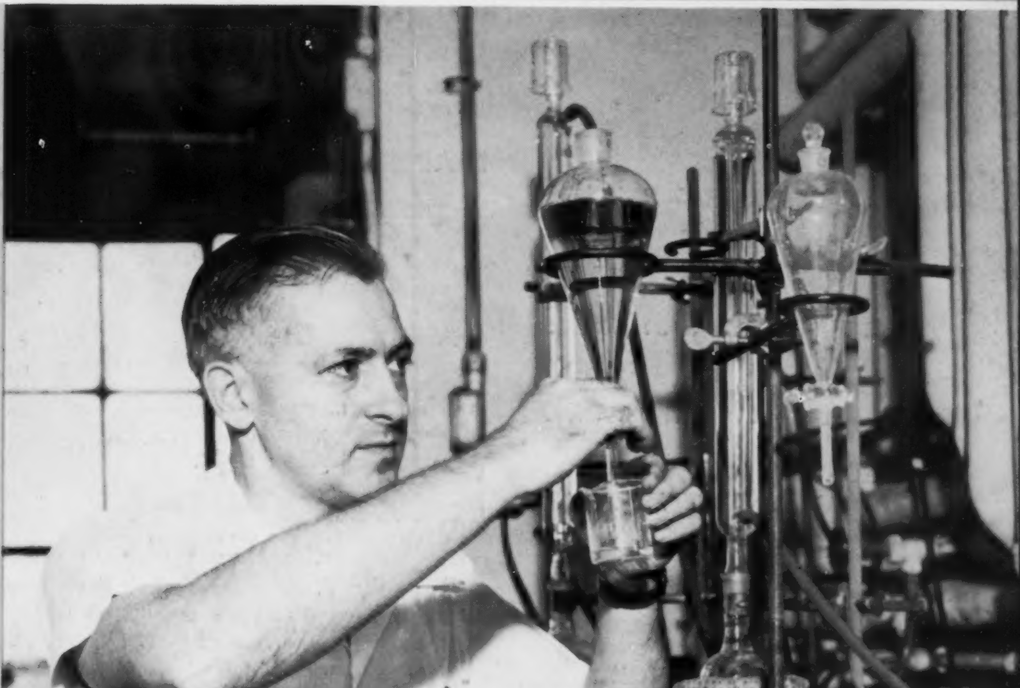
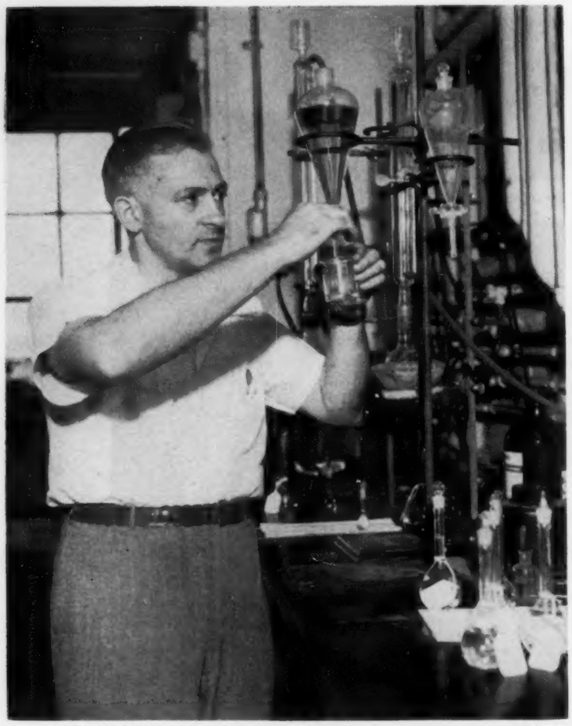
THE SCIENCE TEACHER



JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION



THIS MONTH'S COVER . . . This is a science teacher at work in the research laboratory of one of America's large industries. Like many of his fellow teachers Dr. Novak is displaying the competence of the teacher in the laboratory as well as the classroom. You may read the story of his summer work experience in his article on page 221 of this issue.

Readers' Column

EDITOR'S NOTE. *Thanks to Cyril A. Daldy of Sun Oil Company for helping to arrange for the following news broadcast on the NBC network.*

Extract from 3-Star Extra News Broadcast (NBC network) of September 23, 1954. Ray Henle speaking:

"May I say a word tonight in the hope that this will increase interest in a field in which more of our young people must take part.

"I'm referring to the great need in this country of more young people schooled in science, and the need of more teachers in this field.

"A meeting in Washington today brought together officials of the Future Scientists of America Foundation of the National Science Teachers Association, and industrial firms and professional scientific groups.

"These people encourage young folks in junior and senior high schools over the country to stir themselves up in the study of science. For those who take part there are awards and prizes of savings bonds; for teachers, valuable study fellowships.

"This group invites inquiries by young people interested in following a life of science. The place to contact is the National Science Teachers Association of Washington, D. C."

EDITOR'S NOTE. *We're glad to have the following letter which straightens out some geography.*

. . . I notice from your latest membership directory that you classify members from this territory under the sub-heading "West Africa." May I take the liberty to point out that West Africa and South West Africa are two entirely different countries separated by some two thousand miles of Portuguese territory, South West Africa (of UNO fame) being governed under the flag of the Union of South Africa.

I thought it might be useful to comment on the above matter since members might wish to contact each other and misunderstanding could arise from your error.

May I take the opportunity to congratulate NSTA on what is being done. Ever since I joined in on the NSTA game, I found that my interest in science teaching together with the bound up ideals were returning. I have no regrets for having become a sustaining member!

E. H. KUSCHKE
Mariental, South West Africa

ALDEN H. STRUBLE, 49, died of a heart attack suffered at Western High School, Washington, D. C., on September 30. He had been teacher of chemistry and radio at the school since 1933. He was dismissing his afternoon class as he slumped to the floor and died. A native of Lake Odessa, Michigan, Mr. Struble completed his undergraduate work at Michigan State Normal at Ypsilanti and obtained his master's degree from the University of Michigan. He did additional graduate work at George Washington University.

Mr. Struble was nationally known as co-author of the D. C. Heath textbook, *Chemistry in Action,* along with Dr. George M. Rawlins, Austin Peay Teachers College, Clarkesville, Tennessee. An enthusiastic supporter and active worker for NSTA, Mr. Struble for the past two years has been responsible for the preparation of the Packets. These have been assembled by his science club, Boy Scout troops, and other school groups under his direction. He was active for many years in Boy Scout work and served, along with other DC area members, on an NSTA committee to work with the American Chemical Society in the revision of the chemistry merit badge requirements.

Immediate survivors are his wife, Vivian; a son, Robert, who has just entered his freshman year at Michigan State College; and two daughters, Mrs. Bert Corwin of Long Beach, California, and Mary Jo, 10 years old.

THE SCIENCE TEACHER

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MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year. Library and elementary school subscriptions coincide with the school year or run for one year from date of entry.

Active Membership	$4.00
Sustaining Membership	$6.00
Student Membership	$2.00
Library Subscription	$5.00
Elementary School Subscription*	$5.00
Life Membership	$100.00

(payable in annual installments of $10.00)

* Includes the *Elementary School Science Bulletin* in quantity lots.

Coming . . . .

- Analysis of a Science Talent Search Examination
- Science Teachers Explore Research
- Improvement of the Junior High Program Through Reading in Science
- A Student Report—Exploring and Developing a Science Interest

Editor's Column

INTERDEPENDENCE

The day of the hermit has passed. Today each man is dependent on many others if he is to live.

A similar situation exists among the scientific disciplines. Within many, distinct specialties have grown up to become almost new fields. Some bridge the traditional boundaries between one scientific discipline and another. For instance, chemists are not usually referred to as such but as physical chemists or biochemists or any of a number of other categories. As the titles infer, the physical chemists work closely with physicists and biochemists with biologists. No longer can there be a hermit science.

Types of employment are interrelated—academic, government, and industry; and so are positions—teaching, research, production, sales, etc. The interweaving everywhere is complete.

It is surprising that it has taken us so long to recognize the corresponding dependencies and interrelationships of educational levels starting in the home and continuing as long as a person is productively employed. Scientific and professional societies traditionally have had close relationships with colleges and universities. Only recently have they recognized the necessity for adding the high school to this training team.

From time to time over the past 25 years or so, committees of the American Chemical Society have studied high school science teaching. Their reports have criticized and recommended. But, once these opinions were recorded, the assignment was considered discharged, a typical national practice.

The situation is changing. At present the approach is as it always should be—that of cooperation. It has been most encouraging to review reports from our 144 local sections and to learn of their cooperative undertakings with high school science teachers in their areas. These do not blanket the country yet but there is at least one in every state and collectively they involve many teachers.

The workshops of our Division of Chemical Education this summer were open for the first time to high school teachers and at one, attendance was about equally divided between high school and college teachers. Several participants indicated that one of the main benefits of these meetings was an increased appreciation by each group of the problems of the other.

With ACS experience as background, the Scientific Manpower Commission, representing all scientific disciplines, has taken an interest; so has the Engineering Manpower Commission. From this should flow great benefits extending far beyond the schools and the professions.

Many of us hope that, with recognition of this interdependence, the cooperation will grow, and blossom, and yield fruit.

Alden H. Emery
Executive Secretary
American Chemical Society

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Articles published in THE SCIENCE TEACHER are the expressions of the writers. They are not a statement of policy of the Association or the Magazine Advisory Board.

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

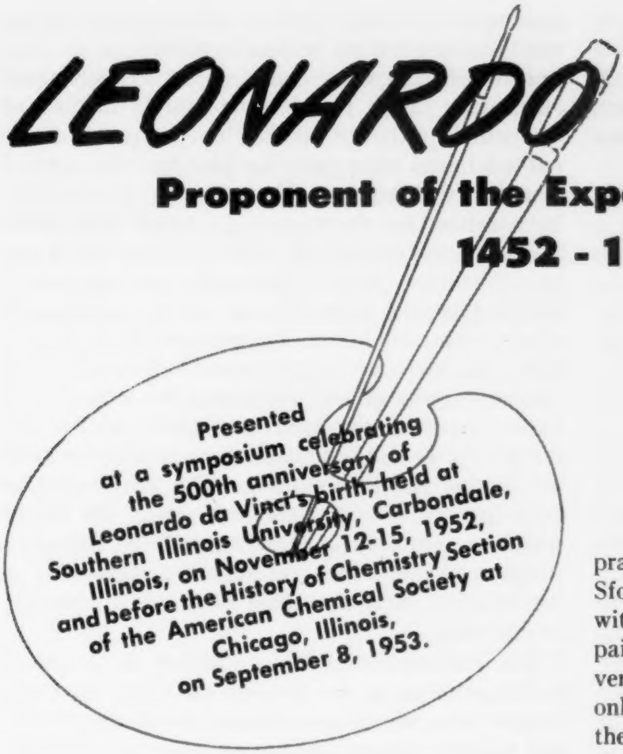
LEONARDO DA VINCI

Proponent of the Experimental Method

1452 - 1519

By ELBERT H. HADLEY

Department of Chemistry
Southern Illinois University
Carbondale, Illinois



THE YEAR 1952 commemorated the 500th anniversary of the birth of Leonardo da Vinci. Some universities held symposia to give him belated honors as a genius far ahead of his contemporaries in many fields. Still, if the average person were asked the question, "Who was Leonardo da Vinci and for what is he known?", the answer would probably be, "He was an artist, known chiefly for his painting 'The Last Supper'." Most scientists would undoubtedly give the same answer, but in so doing they would fail to publicize the forerunner of our modern scientific age and also would overlook Leonardo's greatest contributions to posterity. Da Vinci lived by the artist's brush, but his first love was scientific observation and experimentation. He was chiefly concerned with the physical rather than the biological sciences, not because of the nature of the subject matter but because his chief interests were in work of a mechanical nature.

To da Vinci, painting was only a means to an end, the end being scientific research. His scientific discoveries, uncomprehended and often ridiculed in a nonscientific age, were unknown or forgotten, only to be rediscovered at a later date by men now famous in scientific history.

Da Vinci preferred to be known as an inventor or a military engineer, as indicated in his self appraisal included in a letter of application to Count Sforza. There he listed his many abilities, ending with only a brief statement that he was also a painter and sculptor. Considering a list of his inventions and other basic discoveries, one must not only agree with his self appraisal but place him in the front rank of scientists of all ages. To him should be credited more than 120 major inventions in at least nine different fields, including the submarine, airplane, camera, roller bearing, canal locks, speedometer, telescope, and hydraulic press, together with much basic knowledge in other fields such as botany, geology, meteorology, physiology, and physics.

Leonardo da Vinci was the first man of a new era. He had faith only in experimentation, as he reiterated many times in his notebooks. He said, "Those sciences are vain and full of error which do not terminate in observation. I will experiment before I proceed because my intention is first to set forth the fact, and then to demonstrate the reason why such experience is constrained to work in such a fashion." Also he stated, "Before making this case the general rule, test it by experiment two or three times and see if the experience produces the same effect. Experiment never deceives, it is only our judgment which deceives us. Avoid the prescriptions of speculative persons whose arguments are not borne out by experience. Those who fall in love with practice without science are like a sailor who enters a ship without a helm or compass and who never can be certain whither he is going." This attitude of da Vinci is essential to the method which characterizes the modern physical sciences, where observation, prediction, and check by controlled experiment all depend for their success on their re-

duction to quantitative treatment. At the end of the 15th century he was consistently employing the experimental method which is commonly thought to have been first used in the 17th century. Leonardo da Vinci was truly the rising sun of the Renaissance in science.

In the era prior to Leonardo, many of those who had been actual experimenters had developed a chemistry with a mystical flavor which expressed itself in alchemy. Originally the alchemist sought to purify materials so as to obtain the "quintessence" which was apparently identical with the philosopher's stone. This was expected to perform wonders, such as to heal all diseases, regenerate the character of the discoverer, and incidentally change base metals to gold. At the time of da Vinci the aims had degenerated to a search for a means of transmutation of lead to gold. Leonardo was not attracted to that popular mirage of alchemy. The alchemists that he knew did not seek to advance their art by discovery of new methods but by the rediscovery and interpretation of old writers who were believed to possess the secret, and by recording as a matter of general interest that which had been trade secrets to the master craftsmen. The methods of the alchemists were essentially those of the old Egyptian procedures; thus they were empirical rather than scientific in nature. Both the ideal and methods of the alchemists were entirely foreign to Leonardo's fertile mind. He had a low regard for alchemists, particularly because of their chief aim of transmutation of lead to gold. A young man came to Leonardo's patron one day claiming to possess the true art of magic and exorcism and thus able to disclose the most occult secrets of nature. Da Vinci hotly attacked these superstitions, saying, "Of all the things men talk of, the most foolish is the belief in necromancy, the sister of alchemy."

Transmutation

The concept of transmutation particularly came under his scathing remarks when he said, "It seems that nature revenges itself on those who wish to work miracles—and those who want to grow rich in a day live for a long time in great poverty, as always happens and to all eternity will happen to alchemists, the would-be creators of gold and silver, and to engineers who would have perpetual motion, and to those supreme fools, the necromancers." And again he said, "Oh! speculators on perpetual motion, how many vain projects in this search have you created. Go and be companions of the searchers for gold." In a less vociferous but more scientific manner Leonardo stated in the midst of a discussion on anatomy, "Man is nature's chief instrument because nature is concerned only in the production of elementary things, but man from these elementary things produces an infinite number of compounds although he has no power to create natural things except another like himself. And of this the old alchemists will serve as my witness who have neither by chance nor deliberate experiment succeeded in creating the smallest thing which can be created by nature. By study and experiment they are seeking to create not indeed, the meanest of nature products, but the most excellent, namely gold. If insensate avarice should drive you into such error, why do you not go into the mines where nature produces this gold, and there become her disciple? She will completely cure you of your folly by showing you that nothing which you employ in your furnace will be numbered among the things which she employs in order to produce this gold. There is no quicksilver, no sulphur of any kind, no fire or other heat than that of nature giving life to our world."

The low regard da Vinci had for alchemists is well illustrated in the incident in which da Vinci learned that one of his contemporaries, de Zerbio, had been dissected alive by command of a Dalmatian prince. When told of this Leonardo dryly commented, "An alchemist with so many errors on his conscience well deserved his penance." At least it is a good thing for us who are scientists that this belief of da Vinci's was not passed on to the research directors of today.

Leonardo did accept some of the mistaken concepts of the alchemists of his day. He apparently accepted the idea that all material is composed of varying amounts of only the four elements, earth, air, fire, and water, for he said, "Of the four elements water is the second less heavy and the second in respect to mobility." Also he shared the mistaken theory of the "vital force" necessary to prepare natural compounds, for in his statement previously quoted he said, "Man is nature's chief instrument because nature is concerned only in the production of elementary things, but man from these elementary things produces an infinite number of compounds although he has no power to create natural things except another like himself." The mistaken concept of illness was accepted by da Vinci for he said, "Illness is the want of harmony of the elements in the human body, and medicines reestablish the good relations between those elements." The only good explanation that can be offered as to why an observer and experimenter like da Vinci should accept these and other erroneous concepts

is that chemistry was not his forte. In fact, from the evidence of his notebooks we must assume that he carried out but few truly chemical experiments.

Preparations

Leonardo did have an interest in chemistry but chiefly as a means for effecting the preparation of paints, varnishes, oils, and other artists' materials which he could not buy. In his notebooks we find many formulas for compounding such supplies. Some were written in alchemical language as his directions for the preparation of "Varnish of the fired surface:—Mercury, Jupiter, and Venus (referring to the elements mercury, iron, and copper). After the paste has been made, it should be worked upon with the sagoma continually until Mercury is entirely separated from Jupiter and Venus." Other of his directions were written in the language of a layman as in his method to remove the smell from rancid oil. "Take the rank oil and put 10 pints into a jar and make a mark on the jar at the height of the oil. Then add to it a pint of vinegar and make it boil until the oil has sunk to the level of the mark, and then you will be certain that the oil is returned to its original quality and the vinegar will have gone off in vapor, carrying with it the evil smell." His familiarity with the ancient masters, more than 70 being quoted in his notebook, would lead one to believe that these formulas and directions were not original with da Vinci.

From the many formulas he listed, it is apparent that he had at least a love for compounding artists' supplies. This is well illustrated by the incident in which he was commissioned by Pope Leo to make a painting. Some time later a religious aide to the Pope reported that as yet no progress had been made on the painting since Leonardo had been spending his time distilling oils and herbs to prepare the varnish used to coat the final picture. Pictures in his notebooks of scientific apparatus such as stills, retorts, and the like would lead one further to conclude that Leonardo's chief interest in chemistry was compounding but not research. His research efforts in chemistry as recorded in his notebooks seem to have been limited to a few experiments on closed combustion which were noted as amusing curiosities and some attempts to produce better colors for his paintings. His notes and comments seem to indicate that he was somewhat successful with the colors, at least to his own satisfaction.

Although apparently not a research chemist, Leonardo was a mixture of a chemical philosopher and chemical observer of natural phenomena. He thus recorded many facts and statements of scientific laws often credited to scientists later in history. Some of the more notable quotes from Leonardo's notebooks on subjects with a chemical application are listed below.

(1) *Every action in nature is made in the shortest way.* (Law of conservation of energy.)

(2) *Where flame cannot live, no animal that draws breath can live.* (Need of oxygen for life and combustion.)

(3) *Fire destroys without intermission the air which supports it, and would produce a vacuum if other air did not come to supply it.* (Air is a mixture of gases; oxygen is used in combustion.)

(4) *Everything comes from everything and everything is made out of everything and everything returns to everything because whatever exists in the element is made out of these elements.* (Conservation of matter.)

(5) *Air is capable of compression but water is not.* (Compressibility of gases.)

(6) *Oh! Ye seekers after perpetual motion, how many will-of-the-wisps ye have fashioned. Go rub noses with those who dream of creating gold.* (Non-transmutation of elements.)

(7) *The light of a candle will be proportionately less as it is placed in a colder spot.* (Speed of chemical reactions changes with temperature.)

(8) *The blue flame of a candle is of greater heat and radiance than the smoky flame.* (Complete vs. partial combustion.)

(9) *Iron rusts with disuse and stagnant water loses its purity.* (Oxidation of metals; solubility of gases in water.)

Artist or Scientist?

Why is Leonardo da Vinci thought of only as the artist? The reason may be that his products as an artist are something people have seen and admired because of their preeminence for nearly 500 years, little realizing that the application of the knowledge gained in his researches often was the cause of the outstanding qualities of his paintings. Most of his scientific discoveries, although more permanent and important, remained hidden for a later generation to rediscover and thereby receive world acclaim. His was a non-scientific age with no scientific societies or scientific journals to publicize the fruits of mental and experimental research. Then too, some great discoverers in the past have often been averse to publication, for example, Newton. Indications are that this was also true with da Vinci and that he practiced these mental gymnastics only for his own sake. Also the paths of many great men in

the past have seldom been strewn with roses, but instead they often have met the fate of martyrs, as was true of Bacon, Lullus, Servit, Galileo, Archimedes, and Columbus. Leonardo kept his discoveries to himself by writing all of his notes in mirror script and thus did not meet the fate of many great discoverers but lived to the age of 67, a respected and revered man for his contributions to civilization ...s an artist. It has been left to recent generations ... pay him tardy justice not only as an artist, but ...n inventor, an experimenter, a scientific thinker, ... he originator of the experimental method used ... ch success today.

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and as for Industrial Experience

By BENJAMIN J. NOVAK

Head, Science Department, Frankford High School, Philadelphia and Lecturer in Secondary Education, Temple University

THE National Science Teachers Association and other groups have been advocating industrial work-experience for science teachers. Such opportunities help the teacher to bring more security, practicality, modernity, and enthusiasm to his teaching. The writer is even more convinced of these values after a summer in the Philadelphia Research and Development Laboratories of The Atlantic Refining Company.

The Atlantic Refining Company has long been interested in furthering good science teaching in the schools and has translated this interest into effective action. Atlantic has been a member of the Philadelphia Science Council* since its origin six years ago. This alert corporation for some years has been hiring during the summer, college students majoring in chemistry, physics, chemical engineering, and other lines. Employing a teacher this past summer was in the nature of an experiment.

Thanks to the vision and interest of the company officials, a varied work program was planned. The emphasis was upon providing experience that would be useful to the teacher when he returned to school rather than upon a maximum of laboratory service. A nine-week period was divided among three research laboratories, each conducting a different sort of research. Three half-days were spent in orientation, including a tour of the plant. Thus, there was a rich opportunity to obtain the "feel" of the modern industrial research laboratory from many angles. The sum total of the experiences was altogether valuable, exciting, and unforgettable.

What Does the Teacher Learn?

The teacher feels some of the trepidation of a freshman as he ventures, after a lapse of years, from his classroom into laboratories equipped with millions of dollars worth of equipment, and populated with several hundred outstanding chemists, physicists, and engineers. However, the friendly interest of all the laboratory personnel in the science teacher and his work soon bolsters his confidence.

Equipment in the research laboratories includes much of what is admired wistfully in catalogues, plus especially designed apparatus almost beyond the powers of imagination. One cannot help but marvel at the all but incredible technical powers of the human brain. The electron microscope, electronic computer, polarograph, mass spectrometer (along with emission and absorption spectroscopes), and X-ray apparatus are among the spectacular items. A particular pleasure is the "gram-atic" one-pan balance which permits accurate weighings within less than half a minute. No weights need to be handled. By turning knobs, weights are subtracted from the beam and direct readings shown.

Many pure and applied research problems are being studied, some extending over a period of years. The eighty-person analytical division, for example, is constantly developing new procedures enabling the detection of trace substances occurring only in one or two parts per million. An impurity of this apparently negligible magnitude passing through an oil refinery unit at the rate of 30,000 barrels a day can soon cause serious contamination and breakdown.

One is impressed by the careful and undeviating attention to safety precautions. A mental note is made to press a little harder in this matter upon returning to the school laboratory.

Much of the specialized research in a large laboratory has to do with content and problems that can scarcely be taught as such in a school or college. The importance of a broad, modern scientific background as an educational base is pointed up. Research demands besides the obvious requirement

* A group consisting of representatives from secondary schools, colleges, and industries in the Philadelphia area. Encouragement for careers in science is provided for talented secondary school students by such means as financial awards based on careful screening procedures, summer employment, and special advanced science lessons.

of good native intelligence, initiative, habits of independent thinking, and ingenuity. The science teacher has a great responsibility in providing the opportunity of originality along with factual learning.

Laboratory and other manipulative skills are essential. Machine, wood, and other shop experiences are more useful in maintaining and devising experimental equipment than is often appreciated. The important place of drawing and mathematics needs re-emphasis. Skill in graphical presentation of data is a useful tool of the scientist.

Good English expression, both written and oral, is important. There are careful records to be kept and reports to be made in which concise, comprehensible expression is required. Moreover, a scientist may have a brilliant idea, but officials are less likely to invest thousands of dollars in it if the researcher cannot express his plan logically and coherently. Seminars and conferences require verbal reports of research completed and in progress. The scientist must be sufficiently prepared in oral expression so that he can speak before others in a reasonably able and secure fashion. Scientists have, as a group, been criticized for their apparent deficiency in placing their discoveries before the public in the exciting way that they deserve. There is much in research and applications of science that can capture the spirit and imagination, if suitably presented. Perhaps the scientists and schools can work together to improve this phase of communication.

Scientists are often typed as morose, introverted, pipe-smoking, laboratory-coated recluses. In actuality they are not. They work well with others, and understand the indispensable importance of human relations. The great bulk of modern research is a team effort, and involves the coordinated work of groups rather than individuals. Even one's own individual research assignment proceeds more surely when problems are talked out and reviewed with others. The self-centered and uncooperative individual fits poorly, if at all, into such an integrated environment. Industrial research laboratories of any size require scientists who can lead and organize research teams and take their place in many other positions of administrative responsibility. Scientists are by now well aware of their important social, as well as technical, responsibilities. There is more general agreement that the scientist needs a broad cultural education just as much as he does his scientific training in order to fit his technical contributions into a sensible pattern of civilization.

As one observes the highly qualified, dedicated scientists at work in the industrial research laboratory, one speculates on the beginnings of these careers. How many were encouraged in their choice by an alert science teacher, and how many potential scientists were lost because of the lack of enthusiastic teaching or even of any science instruction at all? There was seen the actual operation of shortages in scientists and engineers. Representatives of the Atlantic Refining Company, in common with other industrial concerns, visit colleges and universities to interview and secure the services of graduates. Superior students can choose from many attractive offers. There are not, however, enough scientists or engineers to meet the nation's needs. One appreciates that the schools must intensify their efforts to discover, encourage, and educate future scientists. One's heart sinks, however, in the knowledge that the many qualified science teachers needed in the schools are not being recruited in anything approaching adequate numbers. Many existing classes in science are being curtailed because of teacher shortages. The outlook for the flood-tide of expanded enrollments that will reach the high schools several years hence is dark indeed. There is needed a coordinated plan between school, industry, and other agencies that will insure a proper channeling of superior scientists into teaching. It is too easily forgotten that the

he well-spring for the flow of

instruments, semi-automatic research calls for many he technicians needed in m ratio of several to each gr er. Many high school studer y interests and aptitudes ting college can be encourag

Scientis parents hence cannot fail to be her and his work. The teacher vi regarded with kindness and r all significant q fficial, a res he can say no contradiction teacher. This i youth, howeve in far greater e industrial s nce teaching a by p actively in his local parent-teacher a d in other community activities. Too school boards understand fully laboratory and other science exp ndit tist serving on a school can be a great

The teacher returns to his school from in with renewed zest. He realizes that his curric is generally on a sound basis, but he has acqu ideas to bring it up-to-date and extend its practicability. He has the extra confidence that comes from having worked with the full-time scientist. He has made friends in industry. The teacher knows that industry respects his work and is gathering forces to assist him in his efforts. All-in-all he is a better, more dynamic teacher.

Some Recommendations

Industrial experience is only one way, but a very important way, of expanding the professional and personal horizons of teachers. Its value is such that it merits expansion on some practical and systematic basis. To do so effectively requires close cooperation between schools and industry. Industry has shown ample evidence of its interest in the aim of better education. In many places throughout industry, much time, trouble and money are expended in providing industrial tours for teachers and students. Ranking industrial officials speak in schools on careers. Industry invests literally millions of dollars in free booklets, samples, and films for use by schools. Some con ze stud rs for special tr

The writer is of the opinion that summer industrial work should be undertaken at intervals by all teachers, especially those in the field of science. There ought to be a salary showing some relationship to the work performed. If the industry wishes to arrange a variety of experiences as was done in the case described, the industry is unlikely to receive a full return in terms of work performed. Nevertheless, the investment is sound on a long-range basis. Even if the establishment places the teacher on one particular job without making any special learning provision, the teacher still can learn much by his own observation and exposure to an industrial environment. In such cases the teacher is of direct productive value, often continuing the work of permanent personnel who are on vacation.

Summer work should not be engaged in every year for the purpose of supplementing the income, but only at intervals, in order to maintain contact with the rapidly changing work-a-day world. The teacher needs to develop professionally along other lines besides directing attention to the restoration of his nervous and physical resources. Thus, ideally, summer experiences should be varied. Collegiate study, travel, camp activity, conferences, workshops, curriculum revision, laboratory and storeroom overhaul, are all helpful when interspersed ith judicious doses of "play" at hobbies, vacation and the like. It is the responsibility of Ameri society to provide salaries for teachers on a that will make unnecessary a scramble for ne and summer employment.

rial establishments interested in the idea o employment for teachers might, through the al Science Teachers Association, or on an in or geographical basis, set up a planned procedu pplication forms could be devised and appli invited in the spring so that a committe ect the teachers for the ensuing sur who the greatest promise of benefiting from the exp ce. The Philadelphia Science Council might w sponsor in its area a summer work program for te chers among its other activities th advance scie e teaching. Pharmaceutical houses, food industrie and other concerns can contribute employment xperience to teachers in other phases of science as well as chemistry. The biology and physics teachers ought not be overlooked.

The time and circumstances are ready. There is no reason why summer industrial work arrangements cannot be made in many places throughout the country for next summer. In so doing, another firm support to the cause of discovering and developing future scientists will be erected.

RECENT DEVELOPMENTS IN ENTOMOLOGY AND THEIR IMPLICATIONS

By DAVID G. HALL

Chief, Publications Branch, Agricultural Research Service, U. S. Department of Agriculture

YOU have heard much in recent years about the conservation of our resources. Each of you knows reasons why we should conserve our wildlife, our soils, and our water supplies. Yet the insect problem probably has not been brought to your attention.

Insects kill more trees than fire and disease combined. At least 100 million acres of our soil are used each year to produce food for insects.

Without insect control, the annual per-acre yields of our soil, and our livestock production, would be half or less than that of today. In addition, thousands of our people would die each year, and hundreds of thousands would be ill from the diseases insects carry. Chances are, without insect control, our economy would be quite different from what we know today.

Profession of Entomology

The *profession* of entomology is 100 years old in 1954. Research on insects is much older, but it was not until the appointment of two entomologists to government positions in mid-1854 that anyone received pay for his efforts against insects.

In these 100 years, about 6500 persons have become members of this profession. About 4500 are professional entomologists today. Of these, only about 1000 spend full time on research.

Yet the efforts of these professional entomologists have aided this nation to become one of the strongest, healthiest, and best-fed on earth.

The profession of entomology has taken stock of its 100 years. The conclusion reached is that the public must be given a greater understanding of the insect problem because over the next 100 years the problem will be more difficult—the need for insect control even greater in the future than in the past.

Why do entomologists believe this? Please allow me to take you on a personally conducted tour through parts of the insect world; then, you will be able to judge for yourself.

Prehistoric Insects

The prehistoric story of insects was written in the rocks of Colorado, Kansas, Oklahoma, and many other places long before man appeared on earth. Some of the insects of today show no major evolutionary changes in the 250 million years that have passed. The difference between ancient fossil roaches and those living today is exceedingly slight.

The oldest known insects show no transition to other arthropods. Thus, the exact time of their origin is pure conjecture—but it was at least as far back as the Lower Carboniferous (Mississippian) Period—considerably more than 250 million years ago.

Numbers and Kinds of Insects

For some 250 million years, insects have been able to flourish. Today, literally thousands of species live together in nearly every ecological niche. They stand supreme in numbers and are in direct competition with all other higher forms of life on land. They probably outweigh all other forms of land animal life put together, and this tremendous mass of protoplasm is derived directly from the present and future fertility of our soils.

The number of kinds or species of insects is so great that even the entomologists cannot keep accurate count. The names of the known kinds is estimated at 500,000 to 1,500,000. But how many kinds would there be if all of them were known and described? Recent guesses vary from 2,500,000 to 10,000,000.

The latest figures on the number of species of insects in North America show nearly 82,500 kinds, plus some 2500 kinds of ticks and mites. Some 10,000 are injurious to man and his economy.

Great reproductive capacity is common in the insects. If all lived, the descendants of one female aphid, or plant louse, would amount to 1560 followed by 21 zeros—1½ octillion—by the end of one summer season.

Some insects lay eggs continuously over long periods. Ant queens can lay as many as 340 eggs a day. Honey bee queens can lay 1500 to 2000 eggs in 24 hours. Termites hold the record—a capacity of 6000 to 7000 eggs a day, and they may live 50 years!

Polyembryony is a remarkable method of reproduction in some insects. This is a process whereby

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two or more young result from a single egg. In its more simple form, one egg divides into two. But some insects do not stop there—the parts of the original egg may keep on dividing and as many as 1500 to 2500 insects finally result from a single egg.

Limited studies have been made of normal insect populations in certain situations. There can be several hundred million in a single acre.

We shall never know how many insects there are, or possibly how many kinds exist. Combining such contradictory qualities as "adaptability" and "specialization," insects hold a key position in the economy of almost all living things. Scarcely a plant exists that does not contribute to the needs of one or more kinds of insects, and a considerable segment of the insect world has become adapted to living off larger forms of animal life—including man.

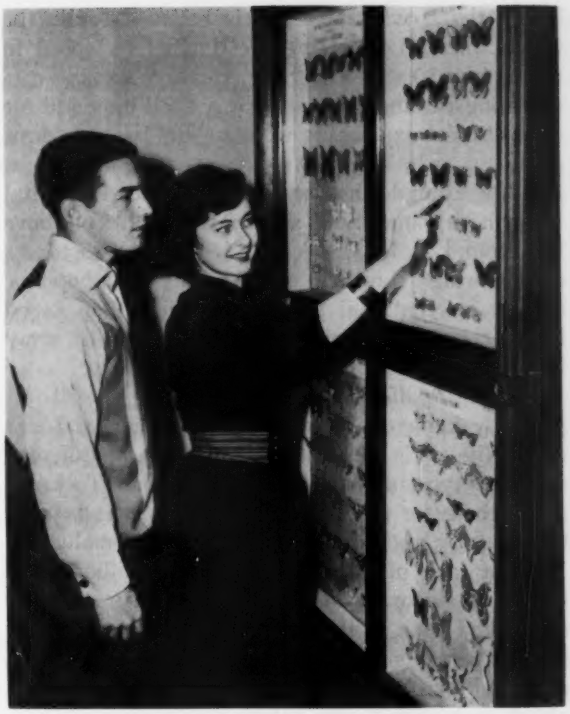
Adaptability and Specialization

Insects are able to maintain themselves in a greater number of ways, and to avail themselves of a larger number of resources, than any of the other animals.

Ocean water striders skate over the waves hundreds of miles from shore. They lay their eggs, and often live their whole lives, without ever seeing land. Butterflies in the Andes of Ecuador are found 16,500 feet above sea level. Snowwhite, blind insects live deep in caverns beneath the earth's surface. Springtails skip across snowbanks during February in northern States. Certain flies breed in the brine of the Great Salt Lake in Utah. One little fly spends its early days in pools of petroleum. Another insect lives in the mud of hot springs at temperatures of 120° F.

Consider the dominant position of the female insect as a matter of both insect and human survival. She is the foundation, the perpetuation, and multiplication of the species. In many insect species, the female is the all—for males do not even exist.

Among the many qualities that permit insects to compete more successfully than any other form of animal life are the hard, elastic, tough, exoskeleton with powers of renewal and resistance to corrosive chemicals; many protective devices such as hairs, rugosities, spines, and scales, as well as folded wings; the ability to lose and even regenerate certain appendages; protective coloration and devices for mimicry; excretion of protective fluids, resins, offensive glandular material, poisonous body fluids and gases; stinging hairs; specially-constructed living quarters in plant tissues, water, soil, and debris; the enveloping and protecting cases of wood, earth, waxes, and paper; the webs, cocoons, spittle, nests, and galls; the habits in animal hosts; the numerous



Gene Bush of Oxon Hill High School, Oxon Hill, Md., and Jean Coulter of Cheshire, Conn., look over the insect collection at the National Museum, Smithsonian Institution, Washington, D. C.

means of escape through complicated processes of death feigning, jumping, snapping, and flight; the aggressiveness exemplified by ants, mosquitoes, bees, wasps; the ability to bite and sting; the ability to reproduce in such numbers as to overcome almost every opposing factor. These are the weapons with which insects counter man's inroads on forests and native vegetation and other habitats of insects, the cultivation of onetime grasslands, the draining of aquatic breeding places, and the devices of chemical and biological control. These are the reasons why insects will probably be on this earth when all traces of man have gone.

A Smattering of Biology

The immature stages of all insects and all stages of many insects are wingless. Thus, early in life they learn to walk, crawl, run, jump, and hop. Six legs enable the adults to move along at a rather even and rapid pace. Certain running insects travel extremely fast and are gone in a flash. Many insects jump. Aquatic insects are efficient swimmers. In maneuverability, insects probably outshine all other animals.

Only adult insects have wings. There may be a single pair, as in the true flies; ordinarily there are two pairs. The flight of insects is remarkable almost beyond belief. The plump and lazy-looking

botfly that parasitizes deer is believed to be the fastest flier. One scientist estimated its speed in excess of 650 miles an hour. Insects can be carried long distances in many ways. Winds and air currents pick up minute wingless and winged forms alike and carry them for many miles. The wingless flea, for example, has been caught in experimental traps in airplanes flying several thousand feet above the ground. Many species migrate long distances on the wing. Locusts, or migratory grasshoppers, are an international problem because they breed in one country and migrate hundreds of miles away to devastate agriculture in another country.

The entire life cycle of most species is still imperfectly known. Between the beginning and end of the life cycle there may be three to 17 different stages or types of individuals to appear. To know all of these for more than a few groups is beyond the capacity and experience of most entomologists. Just for sake of interest, let's say 5 million individual types or species of insects occur on this earth, and each of them has an average of 10 different stages in its life cycle. That makes a total of 50 million different kinds of insect life to know about, each with its own habits, places where it lives, things it eats, and all the other factors that make it different from any other insect.

There may be little difference in the appearance of the various stages of the so-called primitive insects, such as silverfish. Other insects may have a gradual or direct metamorphosis in which the several stages look much alike anatomically, such as the grasshoppers and roaches. Higher insects pass through complete and complex changes having egg, larval, pupal, and adult stages, such as the moths, beetles, flies, and bees.

Insects can assume an inactive condition for short or long periods, so they are able to survive the heat of summer, cold of winter, and unusual periods of drought. Hibernation is almost universal among insects. The winter may be spent as an egg, a larva, a pupa, or an adult. Because insects can withstand very low temperatures, they normally suffer no serious losses during winter within their normal range. It is often a great surprise to many people when they learn that the Arctic mosquito problem is one of the most severe we know. Hibernation by rather fragile forms like mosquitoes and butterflies in sheltered, relatively dry places out of doors therefore is quite common and successful.

Feeding

All forms of animal life need organic matter to exist, grow, and reproduce. Insects are highly efficient in using every available source of food. They consume every kind of plant product, including the entire living and dead plant from root to top. Insects feed on other animals, including insects themselves.

Farmers always have known that many species of insects feed only on a particular crop or series of crops. They appear season after season and evince an unvarying predeliction for the plants that nourished their forebears.

Beneficial Insects

Many insect species are friends of man. Some improve the soil. Some hasten the decay of animal bodies and their return to the soil.

We call some helpful insects predators and parasites. Predators are the lions and tigers of the insect world. Parasitic insects are less spectacular in their work but are more interesting and helpful to man. They attack insects of all types in all stages of development.

Beneficial insects are indispensable to man because they help pollinate his crops. Bees are much more valuable to our economy as pollinators of more than 50 crops than as honey gatherers. Honey bees are sometimes shipped thousands of miles just to help pollinate plants.

Wild bees also help in pollination. But clean cultivation practices are wiping out many of their nesting sites. It may become necessary to determine soon how valuable such bees are for pollination and whether nesting sites can be reserved for them.

Destructive Insects

Only a few thousand insects are destructive—but the damage they do to our economy is beyond belief. Every minute of the day and night insects are chewing, sucking, biting, and boring away at our crops, livestock, timber, gardens, homes, mills, warehouses, and ourselves.

Mosquitoes, flies, gnats, bugs, fleas, ticks, and mites exact a toll in human disease, efficiency and money—lost time from work, the cost of screens on homes, interference with the cultivation or harvesting of crops, and loss of business at resort areas.

Insects cause both direct and indirect losses to timber production. We rarely think of some of the indirect losses. They include fire hazards of insect-killed trees in the forest, effect on soil and water conservation, spoiling of beauty in parks and other scenic areas, or on streets and properties in cities and towns.

Food and homes suffer from insect attack. Insects attack grain while in farm storage, in transit,

(Please continue on page 241)

A *Key* TO THE SCIENCE INTERESTS OF JUNIOR HIGH SCHOOL STUDENTS

By HAROLD S. ANDERSON

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Junior High School Science Teachers Should Know the Interests of Their Students.

RECENTLY, a seventh grade science class visited a hospital. During the entire tour, the members of the class listened raptly to the hospital director's explanations of the equipment and facilities of the hospital. They were interested. Teachers and parents who know them realize that such an interest is typical of this age group.

Unlike adults, seventh graders are interested in everything that goes on about them. Their questions are typically: "What makes it work?" "Why does it look like that?" "How does it happen?"

Wise science teachers are taking advantage of this natural inquisitiveness. They are gaining awareness of the importance of children's interests for effective learning. Since it is known that children will work harder, and learn more about science topics that are interesting to them, why not use their interests to guide the selection of science subject matter and activities?

Science in the community is one topic of interest to seventh grade students. Television is another one. This year the seventh grade science class studied television. They didn't learn how to construct or repair a set, but they gained a basic understanding of the principles involved. They learned how the image was televised and broadcast, the function of the antennae, and how the image is reproduced on the screen.

It would be difficult to list all of the scientific principles which were encountered by the students in their problem solving activities about television. They studied such topics as radio waves, electricity, electrons, vacuum tubes, light, and atoms.

How Can Interests in Activities and Subject Matter In Science Be Determined?

It is as important to know what students are interested in *doing* in science as it is to know their interest in subject matter. For years teachers and administrators have used various devices to determine the interests of students. One of the common methods used has been some form of questionnaire. Too often these questionnaires have included only direct questions about different topics or fields of subject matter. It is questionable whether the results indicate the students' natural interests, and they have not determined the activities of science in which students are interested.

Since students' associations with science are made through a variety of activities, it would seem desirable that a questionnaire determine not only in what students are interested but also what activities they are interested in doing. Can indications of both interests be determined in one instrument?

With this question in mind, Dr. Donald G. Decker, Chairman of the Division of Sciences, Colorado State College of Education, worked with pre-service teachers in the fall quarter, 1953, to originate a new kind of science-interest questionnaire.

The questionnaire consisted of two main parts, activities and subject matter. Eighteen different activities are included in the questionnaire, such as: owning, using, seeing, hearing, taking apart, discovering, and giving reports. The items include these five major areas of science: 1. *Living Things*, 2. *The Human Body*, 3. *The Earth*, 4. *The Universe*, and 5. *Matter-Energy*.

The questions are grouped for convenience in tabulating. Questions pertaining to living things are numbered 1 and questions pertaining to the human body are numbered 2.

Parts of the questionnaire are shown below:

2. What have you used?

   1. Have you used a chemical to make a plant grow better?
   2. Have you used a microscope to examine cells from a human body?
   3. Have you used a compass to find directions?
   4. Have you used a star map to locate stars?
   5. Have you used a nail and some wire to make your own electromagnet?

2a. What would you like to use?

   1. Would you like to use different chemicals on plants to see what would happen to the plants?

2. Would you like to use a machine to measure your brain waves?
3. Would you like to use a Geiger counter to search for uranium?
4. Would you like to use the instruments in an observatory?
5. Would you like to use a radio that you could talk into yourself?

The Subject Matter Interests of Junior High School Students Are Diversified.

When completed the questionnaire was used by the author in determining the interests and past activities of 55 pupils in the Colorado State College of Education Laboratory School. These students were in seventh and eighth grade science classes and were divided by sex as shown in column 2 of Table I.

The tabulated results were found to contain a great deal of knowledge about the students. In computing the groups' interests in the five areas of science covered by the questionnaire, the number of affirmative answers to all the questions within each area were totaled. Table I shows the number of affirmative answers given to the topics within each area by the different groups of students.

Although the results show a slightly greater number of affirmative answers in certain areas for all groups, the preference for one area over another area is not great. Much greater differences, preferences for certain areas, were noted in the answers of individual students.

Boys and girls of both grades were very interested in activities that involved the area of living things. Boys in both groups showed more preference for matter-energy than for the human body, and conversely, girls were more interested in the human body than in matter-energy.

What Activities are of Interest to Students?

A comparison of the responses to the questions in the various activities revealed some worthwhile information. For instance it was discovered that many of the things in science which students are most interested in doing are things they have done most often in the past.

In the tabulation of activities in which students were most interested and had had experience, the number of affirmative responses to questions within the 36 parts were reduced to percentages of the total number possible (275). For comparison the activities were then tabulated separately and ranked. The results of this tabulation are given in Table II.

The relationship between activities encountered in the past and those of current interest can be seen by comparing columns 3 and 8. Six of the activities—hear, solve problems, study, work with, own, and see—ranked in the first half in both past and current interest.

Many educators believe that problem-solving activities are the means to better learning experiences in science. It is interesting to note that "solving problems" ranks high in both columns. The rank of "studying" in both columns 3 and 8 would imply that students do not mind studying. Perhaps their resentment to studying, apparent at times, stems from the topics studied and not primarily from the activity itself.

TABLE I

RAW SCORES OF AFFIRMATIVE ANSWERS WITHIN THE FIVE BASIC AREAS OF SCIENCE DIVIDED BY GROUP AND SEX

GROUPS	NO. OF STUDENTS	LIVING THINGS	THE HUMAN BODY	THE EARTH	THE UNIVERSE	MATTER-ENERGY
1. 7th-Grade Class	26	417	359	329	362	358
2. Boys	10	194	134	148	140	174
3. Girls	16	223	225	181	222	184
4. 8th-Grade Class	29	735	667	584	557	648
5. Boys	16	397	373	340	320	397
6. Girls	13	338	294	244	237	251
7. Group total	55	1152	1026	913	919	1006

TABLE II
RANK, NUMBER AND PERCENT OF AFFIRMATIVE RESPONSES TO ACTIVITY ITEMS

HAVE DONE					WOULD LIKE TO DO				
NO. 1	RANK 2	ACTIVITY 3	NO. 4	PER-CENT 5	NO. 6	RANK 7	ACTIVITY 8	NO. 9	PER-CENT 10
1	1	Solved problems.	177	64.36	1	1	Hear..........	193	70.18
2	2	Played with.....	172	62.54	2	2	Solve problems..	175	63.64
3	3	Seen...........	151	54.9	3	3	Study..........	172	62.55
4	4	Studied........	144	52.36	4	4	Use............	169	61.45
5	5	Heard..........	143	52	5	5	Find out.......	165	60
6	6	Worked with....	140	50.9	6	6	Work with......	164	59.63
7	7	Worked on class projects......	137	49.82	7	7	Own...........	153	59.27
					8	8	Discover.......	161	58.54
8	8	Taken apart....	134	48.73	9	9	See............	160	58.18
9	9	Owned.........	133	48.36	10	10	Go.............	158	57.46
10	10	Asked questions.	129	46.91	11	11	Read..........	154	56
11	11	Wondered......	126	45.82	12	12	Ask questions...	153	55.64
12	12	Found out......	121	44	13	13	Take apart.....	151	54.9
13	13	Discovered.....	121	44	14	14	Play with......	147	53.45
14	14	Read..........	119	43.27	15	15	Explain........	138	50.18
15	15	Gone..........	116	42.18	16	16	Work on class projects......	134	48.73
16	16	Used..........	108	35.64	17	17	Wondering.....	126	45.82
17	17	Explained......	89	32.36	18	18	Give reports....	108	35.63
18	18	Given reports...	83	30.18					

Activities involving the giving of reports have not been experienced extensively nor are they of interest to the students in this group. The ranks of past and current activities may be a cause-and-effect relationship or it may not. The wise teacher, however, may well take such indications into consideration in planning classroom exercises.

The Teacher Should Provide Opportunities For the Satisfaction of Students' Interests.

From the results of this sample use of the questionnaire, a number of conclusions can be drawn concerning the way junior high students should be instructed in science. The almost equally indicated interest in all five areas of science shows that the science curriculum should be highly diversified for this level. In keeping with this concept, the science taught at this level should, and can, form the broad background of concepts upon which later study in senior high school and college science courses will enlarge.

At this age, future scientists can be developed. There is cause for grave concern among our scientists and statesmen who realize that the nation is far short of having an adequate number of trained scientists, scientific technicians, and science teachers. In this day of rapid scientific development the shortage of scientific personnel has serious implications.

A probable cause for it can be found in the past teaching of science, especially at the junior high school level. For too long, science has been taught as groups of facts to be learned and laws and principles to be memorized. All of which may be necessary, but they are not *as such* extremely interesting to children. Too, the activities in which students engage while studying science may well influence their opinion of science as a prospective occupation. Science classroom activities which are

dull and uninteresting will certainly not develop a liking for future study or work in scientific fields.

It appears then that it is up to science teachers to alleviate this situation. We at least partially realize the importance of present science teaching to the quantity and quality of future scientists in our nation. Further, all members of our highly technical, modern society, regardless of occupation, are in constant association with science. They must be given the opportunity to engage in experiences which will help them take their places as members of a scientific society.

What is the correct way to go about it? One way has been outlined here. By using the natural interests of students, we can offer them more meaningful experiences in the fields of science. The result will be a better understanding of, and more interest in, science on the part of the students.

To accomplish this, we must know their interests. One of the methods which can be used to determine interest has been mentioned here.* There are others, perhaps some of them better. The importance lies not in *how* the interests of students are determined and *how* they are used in the classroom but that they *are* determined and used.

* A copy of the questionnaire can be obtained by writing Dr. Donald G. Decker, Chairman, The Science Division, Colorado State College of Education, Greeley, Colorado.

Children's Books enrich elementary science

By NANCY LARRICK

Science Editor, Random House, New York City

An inviting array of science books for children is becoming an important part of every elementary grade classroom, school library, and home bookshelf. To the teacher these books are important because they add rich supplementary material that children seek out voluntarily and enthusiastically. To the children they are important because they supply detailed and authentic answers to many of their immediate questions.

For, given a chance to follow up their own urgent queries, elementary school youngsters head naturally and eagerly into the science field.

This prevailing curiosity about the facts of science showed up very strongly in a recent survey of over 6200 youngsters in grades three through six. The purpose was to try to determine the things children are curious about. Asked to write of one thing wondered about, forty-two per cent stated a query related to some aspect of science. No other subject area received more than twelve per cent of the queries.

The specific questions raised by the youngsters covered a wide range of interests:

"I wonder where the stars go in the daytime."

"I wonder why the moon changes its shape."

"I wonder how television works."

"I wonder how come a caterpillar can change into a butterfly."

"I wonder how the birds know which way to fly in the wintertime."

"I wonder most about the animals and can they talk to each other the way we can."

"I wonder what keeps an island floating."

An analysis of the wonderings about science shows that the greatest number had to do with animal life—insects, birds, mammals, reptiles. Next came astronomy and after that the weather. Very few questions were asked about trees or other plant life.

However, in the 2600 stated queries about science almost every segment of the field was represented—prehistoric animals, glaciers, climate, electronics, space travel, geology, and atomic power, to name only a few.

Today we are fortunate in having many interesting and authoritative children's science books on an equally varied range of subjects. Best of all they are designed to answer children's questions and lead them to further reading in subjects that are of vital interest to them. More and more teachers are recognizing that the day-to-day questions that children ask about the world around them provide ideal motivation for further reading and follow-up discussion.

How Science Books Are Used in Class

To answer children's spontaneous questions, teachers are introducing science books on the spot while interest is high. For example, a sleet storm brings queries about sleet, hail and glaze. Or one child's breathless report of seeing a flying squirrel raises questions about whether these animals "really fly." For each set of questions there are science books giving authoritative answers in language the child can understand and with illustrations that explain. With his own questions as a driving force, the child is ready to read with genuine enthusiasm.

To supplement textbooks and reference books, children are being encouraged to read "a whole book" on a subject about which they have read briefly in other places. The rich detail and many illustrations of such books help to clarify children's concepts and thus encourage them to delve into the subject more deeply.

Kinds of Science Books Available

Among the trade books for children (sometimes called "library books" by the youngsters to distinguish them from textbooks), there are at least five types that deal with science material. Each

serves a different purpose and may appeal to different children at different times.

Experiment books give the child specific directions for testing such scientific phenomena as gravitation, evaporation and condensation, air pressure, osmosis, contraction and expansion, friction, sound waves, and so on. Most of these books are well illustrated and simply written. In general, the directions are easy to follow, and the satisfaction from finding that an experiment really works is tremendously exciting to most young readers.

Informational science books for children are becoming more numerous and more appealing. These are books of non-fiction, so organized and so written that interest is held throughout. Many such books are proving to children that truth is stranger—and more fascinating—than fiction.

Biographies of scientists and inventors add personal details that help to show how we have acquired our growing body of scientific information and inventions. Through such books the facts of science and the ways of scientific research become more interesting to some children because they are given in terms of a personality.

Stories with a science background are available, too, especially for the primary grades. In these the facts of science are part of the setting, but the doings of the hero or heroine are expected to hold the reader's prime interest.

Science fiction has become more and more popular with older readers in junior and senior high school. In such books the plot is often so entwined with scientific believe-it-or-nots that teen-agers and adults race breathlessly on with little attempt to separate fact from fiction.

Points to Consider in Selecting Science Books for Children

As science books are being evaluated, the following questions may well be considered:

1. *Does the author seem to be qualified to write on this particular subject?* (Frequently an identification line on the title page and the blurb on the jacket will tell something of his experience in investigating and reporting on this particular subject.)

2. *Is the material timely?* (The copyright date will tell when the book was published. With such subjects as space travel and electronics, this factor assumes greater importance since new research is constantly adding to our body of information.)

3. *Is the material well organized?* That is, does the information seem to follow logically so that one explanation builds on previous information? (Frequently this can be tested by studying the table of contents and the subheads within the chapters, but the best test is to read the entire book with this question in mind.)

4. *Are the explanations clear for the particular child?* (This can be tested by reading selections and noting the choice of words, the length and arrangement of sentences, and the figures of speech. For the most part, children seem to prefer the exact terms of the scientist, but simple definitions and telling pictures are needed to make those words meaningful. The most effective figures of speech are usually those that put the explanation in terms of the child's own experience. For example, "This dinosaur was as tall as a two-story house is today.")

5. *Are the illustrations and their captions self-explanatory?* (Children are often discouraged by illustrations which are not clearly labeled or captioned. Look carefully to see whether each one tells a complete story.)

6. *Do the illustrations and text challenge the young reader to think for himself, to seek further information, to observe and question?*

7. *If the book is non-fiction, does it have an index to encourage easy reference?*

One of the most helpful guides in the selection of science books for children is included as part of "A Bibliography of Books for Children" published by the Association for Childhood Education International, 1200 15th Street, N.W., Washington 5, D.C. (Price $1.25). The science section was prepared under the direction of Dr. Herbert S. Zim, Professor of Education at the University of Illinois. It is an annotated list of science books grouped by subject with approximate grade levels. Evaluations have been made by teachers who know the tastes and interests of children.

NEEDED— A NEW SCIENCE CURRICULUM

By JACOB M. SKILKEN
Teacher of Chemistry, Walnut Hills High School, Cincinnati, Ohio

THE WORD "NEW" frightens some people. However, the time finally arrives when the "new" becomes imperative. The importance of scrutinizing our school science programs with a view to change is clear when we consider the need for individuals with scientific preparation in industry, medicine and medical research, and in the defense of our democracy. The technological advances of our nation have gone on at a constantly accelerating rate since the end of the war, and the outlook is for an even greater such acceleration in the future. During the past few years we have continually heard that the need for people trained in engineering and science is not being met. All signs indicate that it may be decades before the production of trained science workers catches up with the need for them, if indeed it ever will.

About 60 per cent of the youth with college ability who graduate from high school never receive a college degree. Many, if not most, of these individuals do not attend college because of financial reasons. A very large number, however, do not go because they do not appreciate the importance of a college education. In this great group of capable boys and girls may be found many with good talent in science whose high school work failed to provide effective stimulation and guidance. Committees, councils, and conferences have been created by industry and the professions to lure young people into scientific fields. However, what better place is there to accomplish this goal than right in the public schools, where frank recognition of the need for change in the science program should be followed by experimentation with new ideas in an effort to find a satisfactory solution?

It is my proposal that we meet this need for change with a unified approach in science study. If this change is made it will necessitate training a new kind of science teacher and providing a new kind of science classroom. I believe the advantages of this approach to be:

1. It fits in with the character of science.

a. Pure science springs from individuals who are capable of taking general and unprescribed views of nature. Today's scientist approaches a problem in research with the attitudes, know-how, and skills of all the sciences. The nuclear physicist studies his microcosm employing the same thinking and techniques as the astronomer. He is a chemist in that he deals with chemical change in matter, which we now know is energy. He is a physicist in that he measures energy, which we now know is matter. Always he is a biologist in that he must note effects on life. He is concerned over psychological, philosophical, sociological, and political implications of his work. The same can be said of any worker in pure science.

b. During the past 20 years colleges have shown that they recognize the need for breaking down departmentalization in science by developing strong courses in physical chemistry, physiological chemistry, biological chemistry, biophysics, geophysics, astrophysics, etc. Courses within all specialized engineering programs are being modified so as to reflect interest in all sciences. Colleges have introduced overview courses in the freshman year showing an apparent trend toward integrated, orientation courses.

2. It will reduce the amount of duplication in learning. The student is frequently forced to live through the same learning experience he has met with in another science course. This results in boredom and consequent loss of interest. Sometimes, because of the way in which this learning experience is presented, he does not even realize that he is meeting with the same idea. This is even worse, for it cultivates in him the feeling that problem solving in one science is very much apart from work in any other science. This attitude is very difficult to give up later on in his education.

3. It will mean less misinformation and half-learning. In this century revolutionary change has occurred in scientific laws and theories. The teacher of the new course will have to be a well informed individual. The nature of his work will force him to take note of change in thinking and new developments in his field.

4. It will mean that more will be learned in high school. The extent of learning in all sciences has

now become so broad that it is not possible to do justice to an elementary chemistry or physics course in one year. More program time needs to be given to the teaching of science. However, this new way of learning will result in greater efficiency.

5. The work will have greater practical value for the student. Because of his broadened viewpoint he will be better able to relate his science learning to the commonplace though often complex problems of ordinary living.

6. It will permit easier correlation of science experience with the social sciences and the language studies. Breaking down the walls between sciences will do much to produce versatile and flexible teachers who can relate their work and their interests to other fields of study.

7. It will build greater confidence in our schools. Educators will be revealed as forward looking, responsive to change, and willing to give effort to research for improvement of education.

Setting up such a program would require the same kind of care that industry gives to its research. The school chosen for the experiment ought to be one taking its students from an area that would be likely to provide talented people. The program in the typical six-year secondary school might be set up in two parts, so as to permit easy transfer to or from another school. The first part would be a course in the natural and biological sciences extending from grade 7 through grade 10. The second part would be a combined course in physics and chemistry for grades 11 and 12. The teacher selected for this work should be one who likes the idea, has great interest in all the sciences and substantial understanding in some, and has high regard for the abstract approach in science study, yet one who realizes the need for finally relating the learnings in pure science to the solution of practical problems, both commonplace and specialized. Liberal attitudes ought to prevail in the making of plans for classrooms and laboratory facilities, equipment, and supplies. All school services, library, testing, counseling, supervisory, etc., might contribute much to the planning and carrying out of this program. The program ought to enlist the aid of certain individuals in industry and the professions to advise students with projects in areas of study in which these individuals are specialists and in which the teacher has only limited knowledge. By setting up favorable conditions for conducting the experiment, school administrators would go a long way toward assuring its success.

PSYCHOLOGY–*minus the mystery*

By ROBERT TYSON

Assistant Professor of Psychology
Hunter College, New York City

Plain facts about the youngest and most misunderstood member of the science family

Colleagues in the enviably exact sciences, lucky you!

No one greets the chemist with: "A chemist! Well! Make me a new miracle fibre!" No one asks with mixed skepticism and amusement: "Do you really think water is composed of gases? I've looked at water a good deal and I've never seen any gases in it." Who would dream of inquiring: "But is physics really a *science?*"

The psychologist often hears this remark, offered half jokingly but a little apprehensively, too: "He's a psychologist, you know. Better be careful or he'll psychoanalyze you!" On occasions supposedly for relaxation he may be cornered for an hour to hear the woes of a whole family of confused and confusing personalities. When the story ends he is asked for a neat, quick solution to the three-generation muddle.

The extent to which psychology is still regarded as a mystic compound of magic, philosophy, science and pseudo-science is far more than a source of irritation for psychologists. It may interfere with full use of the science of behavior in a world which admits that human relationships are a problem and does so little about it.

Misapprehensions about psychology are hardy enough to survive several courses and reside permanently in the otherwise educated mind. They need not be profound. They persist because they are often protected by layers of strong feeling. They are a menace because they block the scientific approach to personality.

Fifteen areas of confusion are outstanding. They are listed below as they occur rather than as separate categories. Let us note them briefly because the scientist reader needs no filling in:

1. *Do you believe in psychology?* People who would consider it conclusive proof of psychosis to ask if you *believe* in physiology entertain quite seriously the thought that the existence of psychological science is a matter of faith. As long as people and lower animals do things, what they do will remain a proper subject to study and, believe in it or not, that study is called psychology.

2. *Which psychology is really "any good"?* Should you have confidence in animal psychology, personality testing, vocational guidance, child psychology, psychoanalysis, or industrial psychology?

Let us ask a physician an equivalent question: "Doctor, which treatment do you prefer, aspirin or a bandaid? Do you think penicillin is better than orthopedic surgery? If he answered at all he would ask desperately: "For what?"

Psychology has come of age. Like engineering it has accumulated a large "tool box" of techniques. A major part of the psychologist's skill is ability to decide what sort of treatment will match each particular problem. One method is good only to the extent that a carpenter thinks his cross-cut saw is "good"—for some special purpose.

3. *Everybody practices psychology.* We have to. Everyday life requires us to judge people and events. But in certain important respects the outcome resembles what would happen if laymen began mixing, heating, striking, and occasionally swallowing a random assortment of chemicals—without being chemists.

Training for chemistry is so obviously necessary. The errors of ignorance in that field are so quickly revealed. However, it is quite possible to hold a completely wrong notion about human beings throughout life and never realize it.

4. *Is psychology a collection of bright ideas?* When a psychologist says fast readers remember what they read it *sounds* like just one more bright idea. It is just as easy to say: "No, *I* think *slow* readers remember more." It seems like one person's word against another's. Both conclusions have an easy air about them. The question that remains, nevertheless, is *which simple conclusion is right?* Only research, not a bright idea, can tell.

In the treatment of complex personality disorders it is the combination of experiment and clinical experience that gives weight to the consultant's conclusions. Yet, other conclusions may actually sound more "sensible."

5. *Isn't psychology just common sense?* A father received a letter from his son saying he could not endure life at college away from home. "Common sense" told the father to persuade his son to stick it out, not give in. It required the son's suicide

to prove that common sense in this case was wrong.

There was a fact to discover in the tragic instance related. If informal methods—common sense—could have led to the deep nature of the boy's disturbance, well and good. They did not. Common sense is often in error and often leads two people to entirely different results. Only the closest adherence to the steps of the scientific method supplies *proof*.

6. *Why not use intuition?* If you have "the power of knowing . . . without recourse to inference or reasoning," congratulations! If with this gift you can set up a selection, placement, and training program for an industrial firm or design an efficient instrument panel for jet fighters, your country needs you!

Psychologists believe that "quick or ready apprehension" can be right sometimes. However, like common sense, it may give two people different answers to the same question. At best intuition seems to be a noble name for the more or less correct use of subconscious cues.

7. *So many* IFS, ANDS, *and* BUTS. Your honors, we plead guilty. Ask a chemist what happens when x and y combine, and he tells you. Ask a psychologist how a man who passes a driving test will do on the road and he hedges in a dozen ways.

How fortunate the chemist! His gas units are identical and their surroundings can be controlled almost perfectly. On the other hand, the driver is not the same even from one moment to the next. The driving test sampled only one aspect of this unstable unit. Drivers with identical scores may vary greatly in their attitudes. Road conditions are never literally the same.

The psychologist's predictions, like those of the insurance company, are actuarial, in terms of probability rather than certainty. His main comfort is his improvement over past "batting averages."

8. *It's hard to be cool about ourselves.* Few people rise to emotional rejection of the laws of matter. But their own faults, prejudices, and fervent wishes are another story and a sad one for psychology. Psychoanalysis, in one sense, could be regarded as a great effort to break down false defenses of the self.

9. *Why couldn't it be simpler?* When intelligence is discussed students may ask: "But isn't attitude important, too?" They must be reminded that only one topic can be taken up at a time and that focus on one does not imply neglect of others. By analogy a medical student listening to a lecture on the heart might inquire anxiously: "But what about the liver?"

The psychologist, like the physician, examines many artificially isolated factors, some with rather rigid procedures comparable with testing blood pressure. This pressure, like many test scores, means almost nothing unless evaluated against the whole background situation. No one index sums up human behavior. Both psychologist and physician must collect many sorts of data to "size up the case."

10. *Don't most psychologists disagree?* No doubt it is more interesting to concentrate on some sensational differences of theory or practice. They exist in psychology as they do in other sciences. Neglected may be the fact that these days psychologists have a vast background of methodological and factual science in common and agree on it.

Often the onlooker seems to have one type of problem in mind and forgets that the psychologist may be considering a different one. Again he apparently forgets that there are many problems calling for different approaches, and that the employment of these in itself does not mean disagreement.

11. *Do psychologists cling eternally to one "school?"* Perhaps some still do. However, the fierce advocacy of "schools" that marked the infancy of psychology has been pushed to the borderland of a growing body of accepted knowledge. A psychologist, like an architect, may favor various trends, but today he represents far more than just one emphasis on theory or practice.

12. *Isn't psychology really* (a) *sociology,* (b) *physiology,* (c) *medicine,* (d) *anthropology,* (e) *economics?* A thousand times yes, of course. The writer has to date discovered no psychologist who would dream of denying this friendly interrelation with neighboring colleages. Nevertheless, the question arises again and again as if it were some breathtaking discovery that should induce fear and trembling in the ranks of psychologists. Any modern clinic is a living example of working collaboration and recognition. An effort to monopolize the study of behavior for one science could be based only on ignorance.

13. *Why do psychologists*—Place complete, unquestioning confidence in test scores? Favor letting children run wild? Break up marriages with their psychotherapy?

Reply: they don't. Most questions about why psychologists follow some hopelessly inane course need the same answer.

14. *Why are psychologists so peculiar?* Possibly psychologists have their own emotional block in the way of investigating this problem! Nevertheless, there has been no reliable study of psychologists'

adjustment compared with that of control groups. It is, of course, only natural that psychologists should find their own behavior the object of keen appraisal, with any existing quirks spotlighted in the process. In reality they are exceedingly modest about holding up norms of "perfect adjustment" either for themselves or for others.

15. *Well, then, what* IS *psychology?* It consists of *any* reliable approach to the behavior of the organism and *any* verifiable information on that subject.

This youngster, among the sciences, psychology, is not really as "difficult" as he seems. He just needs to be "understood."

SCIENCE TEACHING AND THE LABORATORY

By RAYMOND E. KIRK

THE place of the laboratory in the teaching of science in secondary schools is again being questioned. The arguments so familiar forty and fifty years ago are again being brought forward. (However, many of those now decrying the functions of the laboratory as an aid in teaching seem unaware of the old controversy). Perhaps, it is well that those of us who teach science should again be forced to defend the laboratory as a teaching device. Perhaps, we have allowed ourselves to become careless in our use of this tool. What then is the basis for the faith we hold regarding the laboratory?

First, we believe that it is the best known method for inducing young persons to use their minds. How can one be interested in explaining the siphon, if he has never seen one work? How can a young person be intrigued by the phenomena of changing matter unless he has carried out the simple chemical changes. Each human being is a scientist! Each young person should himself have the chance to carry out controlled experiments to demonstrate how scientists work and think. Science is not magic, yet many young persons whose science experience consists only in watching demonstration lectures will be tempted to think so! "One sip is worth ten thousand words"!

Second, we believe that the laboratory is the place where orderly habits can best be established. To observe and then to record in logical fashion what one has seen; to measure and then to report in tabular form the results of those measurements; to relate and then to state concisely one's conclusion; to summarize and then to phrase that summary; all of these are habits whose establishment will make young people better members of our world. Such habits have values far beyond the realms of science.

Third, we believe that the laboratory is the place where the historical development of science can best be taught. It is possible to show how the isolated observation may lead to planned studies; how qualitative experiments lead to quantitative ones; how empirical observations can lead to preliminary generalization; and how the laws and theories of science have their origin. In a world that is filled with the results of science, all too few people have any idea of how science grows, and too many have the wrong idea.

Finally, we believe that it is in the laboratory that the scientists of tomorrow will be recruited. Who has chosen science as a career because it was finished? The concept of science as growing, as changing, and as serving is the concept that attracts keen young minds.

We speak for the use of laboratories in the teaching of science because it is our sincere conviction that we will be cheating young persons if we attempt to teach science without laboratories.

Most of the arguments for the abandonment of the laboratories in the teaching of science are in essence statements that science teachers have failed to accomplish the things which we claim we can accomplish by laboratory instruction. All of us who teach science will admit that we have fallen short of our stated goals. Blame us, but do not blame the method! Help us to do better, help us to train others to do better still, but do not doom our young people to sterile instruction.

The National Science Teachers Association as

SAMA PICTURE RELEASE

DR. RAYMOND E. KIRK, dean of the graduate school of the Polytechnic Institute of Brooklyn and chemistry department head, is this year's winner of the Scientific Apparatus Makers Association's \$1000 award in chemical education. The award, given annually under the auspices of the American Chemical Society in recognition for outstanding contribution to chemical education, was presented at the national meeting of ACS in Kansas City in March.

On the subject of chemical education Dr. Kirk can speak with authority for he has been teaching chemistry for almost 40 years. He is convinced that "entering college chemistry students are far more knowledgeable now than ever before" and that "today's high school graduates are far better acquainted with the applications and implications of science than were students 20 years ago." These are welcome words to science teachers who are weathering the storm of adverse criticism today.

Dr. Kirk received his early schooling in the Nebraska public schools and his B.S. degree from the University of Nebraska. He went on to Iowa State College for his M.S. and later received his Ph.D. from Cornell University. One of the secrets of his success as a teacher and as a scientist and administrator may well be his enthusiasm for his work and his realistic outlook on students' problems.

well as other groups foster programs for the improvement of laboratory teaching. These efforts merit the commendation and support of all interested in the improved education of our youth. Improvement not abandonment is the logical answer to allegations of poor results from laboratory teaching.

The argument based on cost deserves separate consideration. Laboratory supplies and equipment need not be expensive! In many instances less expensive pieces of equipment are better teaching tools than are more costly ones. Many a resourceful physics teacher has used the interests of his students and the resources of his own basement shop to fit out an outstanding laboratory. Yard sticks, spring balances, pulleys, and cords are much less costly than are most items of athletic equipment. The local hardware store has many items that can be used by the resourceful teacher. The same is true of the radio and televison repair store and of the electrician's shop. Baking soda is still primarily sodium carbonate; the effect of its water solution on litmus is still remarkable! The corner druggist is a good source for many chemists; the farm supply store for many others.

Recently, many economical remodeling and building plans for low cost laboratories have been successfully worked out with planning committees composed of the school administrator, science department representatives, the school architect and cooperating laboratory equipment manufacturers. Using standard size equipment (benches, hoods, tables, etc.) in the science laboratory—easily planned for in the initial stage of design—saves a sizable amount of money and provides excellent facilities for the teacher and student. If the equipment manufacturer is consulted after the building is under construction, custom built furniture may be necessary at a consequent increase in cost.

Laboratory apparatus dealers will always be found most cooperative in helping to plan for economical student laboratory courses. Many suppliers make comprehensive lists available to administrators and science teachers noting in detail equipment and supplies designed for the maximum teaching effectiveness at the lowest cost. Textbook publishers, too, are always happy to supply lists of economical equipment for use with their books and manuals.

Actually, it is becoming increasingly important for the secondary school science curriculum to keep pace with the interest being developed in our primary and elementary school grades. As an example, one of the country's apparatus manufacturers recently introduced a completely portable science demonstration cart (Elementary Mobilab) for use in the lower grades. Easily movable from room to room, equipped with various services, equipment of this nature is keyed to make science observation experiences vivid and keyed to whetting the appetite of the student for his own work "someday in high school." What a blow to science education, and future scientists, to discover that ***high school*** biology, physics and chemistry laboratories have been abandoned!

The best equipment in the laboratory may still be "in the head of the man running it" but the most salient challenge to the science student still remains to be his own scientific laboratory work and observation, carefully guided and inspired, and accurately recorded by him as a part of the learning experience.

Hall—continued from page 226

and while stored in elevators. Clothes moths, carpet beetles, pantry pests, and termites invade homes, infest food, ruin clothing, and damage timbers of houses.

A compilation of estimated losses due to 75 insect species was made in 1953 by a committee of scientists of the U. S. Department of Agriculture. They think the damage, plus cost of control measures, is at least $4 billion each year. These estimates did not include the health and recreational factors.

Figures such as these should give us pause. These are estimates for only 75 of our more destructive species. Everyone is affected in many ways by many insects. Losses caused by all insects in this country add up to a staggering amount whether we regard them in terms of dollars, lost food and fiber, or time and materials used in combating them.

People have been plagued by insects through the centuries and have died by the millions from diseases they carry. They carry disease organisms of many kinds—viruses, bacteria, protozoa, roundworms, and tapeworms. The disease organisms in many instances pass from one host generation to another.

How We Fight Insects

From this brief excursion into insect land, you can see why entomologists feel that the need for insect control will be very great in the next 100 years.

Although we know that insects are endowed with marvelous mechanisms for survival, we also know how to fight them. Let me review some of the most effective methods we use to control insects.

Quarantines—The very best way to fight insects is to prevent them from ever getting into the country in the first place. Most of the insect enemies we are forced to fight were brought here by our ancestors.

The airplane potentially is a major distributor of insect stowaways because of its speed. Almost 3000 species belonging to 293 families have been intercepted, many of them alive, inside aircraft. Introduction of new insect pests into an enemy economy might very well be a spectacular weapon during total war.

Charges of the deliberate introduction of insect pests made by one country against another have appeared from time to time in the world press. Such charges appear out-and-out propaganda. It would be a short-sighted gesture in the present stage of world unification for one country to set a destructive pest free in another country.

Insect-Resistant Crops—Growing resistant varieties is an ideal way to protect crops from damage by insects.

The crossing and selecting of crop varieties ordinarily requires many years of cooperative teamwork by many scientists, including entomologists, agronomists, and geneticists, to produce a commercially satisfactory, insect-resistant variety. The breeding and selection of resistant varieties of fruits, nuts, or forest trees, or of long-lived perennials, involve even greater difficulties than the improvement of annual crops.

Cultural Control—Farmers fight their insect enemies when they follow good practices in tillage, crop rotation, planting dates, and field sanitation. Cultural methods such as these help control pests without extra costs in time, money, or convenience.

Insecticides—Insecticides are perhaps the most effective emergency weapon we can use against our insect enemies. They kill insects because they affect life processes such as respiration, digestion, circulation, and nerve reactions. Persons who plan to use them should inform themselves of their characteristics.

But merely to secure effective insecticides, and apply them, is not enough. Insecticides must be used safely. The best material may fail if used at the wrong time or in the wrong way. The user should learn something about the habits of the insects to be controlled, the physical properties of the chemicals, and the influence of weather and type of plant growth on their effectiveness.

If you don't know the insect, find out what it is from your county agricultural agent, extension entomologist, or similar authority. You can get proper recommendations or advice on the use of insecticides from these authorities, from State or Federal publications, from entomologists representing insecticide manufactures, or from pest-control operators.

Care must be taken to avoid treatments that might kill fish or wildlife. Awareness of hazards and adoption of safeguards in using and storing insecticides are urgently needed. The object of instruction to that end is not to frighten people, so they will not use these treatments, but to get people to observe simple and proper precautions. The intelligent use of insecticides will enable users to do the most good with the least chance of doing harm.

A few of the hundreds of insects that we must control have developed resistance to insecticides. That means, an insect can survive and thrive in the presence of a chemical supposed to kill it.

Spray applications that almost eradicated the house fly a few years ago are no longer effective in reducing fly populations in many areas. Resistance to DDT and other insecticides seems to be correlated with the ability of the fly to degrade such chemicals into non-toxic substances. We do not know the actual mechanism of the process.

Insect Eradication

"Can insects be eradicated?" Yes, it is possible for man to wipe out destructive insects from small areas. When destructive insects first migrate to a new locality, they can and should be destroyed while their numbers are small and the area infested is limited, even though the cost may be great. Otherwise, they may continue to spread and cause losses successively greater each year.

The European corn borer is an example. If we had eradicated it when first discovered in 1916, at a cost, say, of $100 million, the money would have been well spent. Today, this insect costs us that much in an average year.

You Can Help

Today we devote 100 million acres of our soils to the production of food for insects. We can spare this production because we can produce more than we need, in spite of our insect enemies. But our human populations are increasing rapidly. It is inevitable that the time will come when we no longer can maintain our present standards of living—and feed our insect enemies. Too, I am convinced that some of our insect problems are becoming more acute each year. The European corn borer, for instance, will not reach its full potential destructiveness (and it did $353 millions damage in 1949) until it finally occupies every ecological niche in this country—say 25 years from now. There are other destructive insects of the same category—the Japanese beetle is an example.

Yes—insects have almost every biological reason for surviving man on this earth. They have survived every other age since their beginning, with little change in their ways of life. Man has just one chance to survive this biological battle—it lies in his ability to think. Man can learn. He can record his learning, and pass his knowledge to future generations. Man does not learn easily, and he soon forgets his past disasters. Already we have forgotten our thousands of dead each year from yellow fever of only 50 years ago.

The time to take stock of such a problem is now. The future of our economy may very well depend upon our ability to bring an awareness of the coming seriousness of the insect problem to our people.

Classroom Ideas

General Science

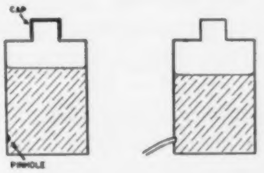
Squeeze Bottle Science

DOROTHY ALFKE, Assistant Professor of Science Education, Pennsylvania State University, State College

New packaging methods have placed in the hands of science teachers a clever piece of instructional equipment. We now find hand lotion, air deodorants, hair cosmetics, and many other materials sold in plastic squeeze bottles which can be rescued from discard for use in the classroom. Let's wash them with soap and water and use them.

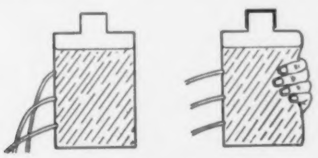
A. Remove the cap and submerge in water. Why doesn't the bottle fill with water? Squeeze the bottle under water. What comes out? What is the evidence for this answer? When the pressure on the bottle is released, what happens? What is the explanation?

B. Use a large needle or similar device to make a small hole near the bottom of one of the plastic bottles. Hold finger over the hole and fill with water.



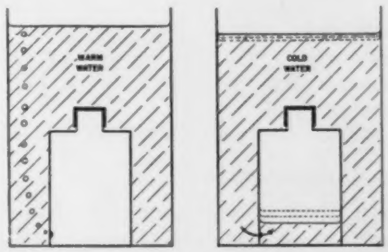
Place a cap on bottle. When finger is removed the water does not come out of the hole unless pressure is exerted on the bottle. How; explain? Remove the cap and the water spurts out of the hole. Explain. (This is an easy-to-prepare version of an old trick.)

C. Make three or more pinholes, each at a different height, along the side of a squeeze bottle. Fill the bottle with water, leave the cap off, and allow the water to flow out of the holes. The difference in the streams of water at the various heights is an indication of the variations in pressure with depth in liquids.



If, however, we fill this bottle with water and screw the cap on, we can show that when pressure is applied to a confined liquid it is distributed equally in all directions. A gentle squeeze will produce jets of equal length. One might wish to make additional holes in the bottle for this demonstration.

D. A so-called "empty" squeeze bottle with a pinhole near the bottom and the cap screwed on can be used to illustrate heating effects of air masses. If this gadget, at room temperature, is placed in a jar of hot water, the heating effect of the hot water will be visible as bubbles of air are forced out of the hole and rise in the water. If this same "empty" bottle is placed in a container of ice water, the cooling effect of the cold water will be indicated by the flow of water into the bottle.



Other applications of science principles might occur to the reader. Certainly there is a place in science classes to discuss the purpose of the air spaces left in many containers of products marketed in squeeze bottles. There have been customer complaints about the partially empty bottles of such products offered for sale.

"Squeeze bottle science" could be used to stimulate interest in a topic to be studied, as a repetition learning experience, or as a novel method of testing for learning.

General Science, Physics

Centigrade-Fahrenheit Conversion Chart . . . A Teacher-Pupil Project

By ALFRED T. COLLETTE,
Professor of Science and Education
and
By HARVEY S. STEINBERG,
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Syracuse University, Syracuse, New York

Students who experience difficulty in understanding the relationship between the Centigrade and Fahrenheit thermometer scales will find this conversion chart an aid in comprehension. It may be

used as a demonstration piece by the teacher or used individually by the students. The original model was made almost exclusively from scrap materials. It can be constructed in 2 to 4 hours. Directions follow the list of materials and tools.

MATERIALS

- Large corrugated box-board (cardboard) approx. 60″ x 12″
- Roll of WHITE shelf paper, at least 18″ wide
- 4 blocks of wood, approx. 2″ x 2″ x ½″
- Oil cloth, enough to make a strip approx. 100″ x 5″
- ¼″ dowel, at least 18″ long
- 1 dozen carpet tacks
- Wood glue
- Red enamel paint
- Black poster paint
- Lettering pen & assorted pen points
- Masking tape or "scotch" tape
- White adhesive tape (1″ wide)

TOOLS

- Hand drill and ¼″ twist drill
- Large scissors
- Tack hammer
- Small saw
- 1 rule, divided into tenths.

DIRECTIONS FOR CONSTRUCTION

Obtain a piece of corrugated box-board (cardboard box) approximately 60″ x 12″. Cut a 3″ x 45″ slot (see Fig. 1) in the center of the box board. (This dimension *must* be exactly 45″).

Cut a piece of white, high quality shelf paper to fit the box board with enough overlap to fold and fasten to the backside of the board (see Fig. 2).

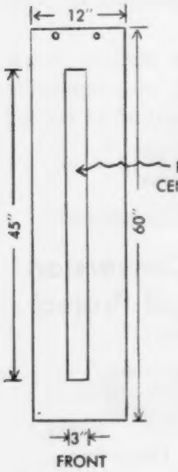


FIGURE 1

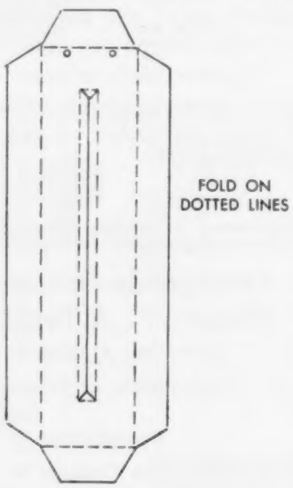


FIGURE 2

Do not cut along the dotted lines in Fig. 2. These are the lines along which the paper will be folded and secured to the backside with masking or "scotch" tape.

The scale can now be marked off on the paper-covered front of the chart (see Fig. 3). On the Centigrade side there will be 101 degrees (0° to 100°) marked off along the 45″ inner margin. Each of these degrees beginning at zero will be 45/100 of an inch apart. Every tenth degree should be extended and labeled 10° C, 20° C, . . . 90° C, 100° C. Every fifth degree can be extended but should not be labeled.

FIGURE 3

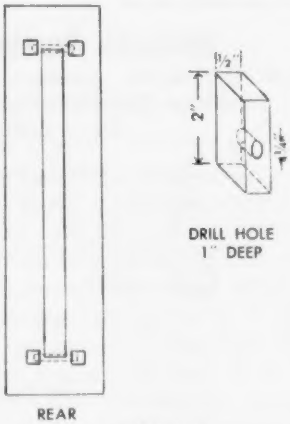


FIGURE 4

The Fahrenheit side is done in the same manner except 181 degrees must be marked off including 32° and 212° (see Fig. 3). Each degree mark will be ¼ of an inch apart.

Use a fairly fine lettering pen point and paint in the degree marks and numbers. Identify each scale (see Fig. 3 or 6). This lettering should be done with black poster paint or ink.

After it has dried, place a protective paper over the face of the chart and turn it over to prepare the movable "mercury" index.

Drill ¼″ holes 1″ deep in each of the four wooden blocks as indicated in Fig. 4. Mount the blocks as pictured with carpet tacks driven from

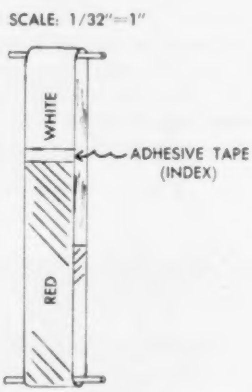


FIGURE 5

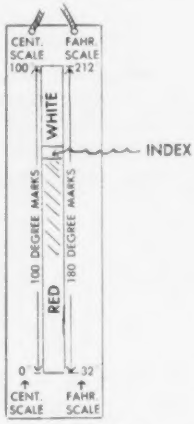


FIGURE 6
Drawings by F. C. King

the front of the chart. The heads of the tacks can be painted white to be less conspicuous. (The blocks can be put on before the paper facing is secured but they will interfere with fastening the facing to the backside of the chart).

Cut the dowels so that each will fit well into the the holes when the boxboard is bent along its length.

Sew the oil cloth together so that a band approximately 93″ x 5″ is formed (see Fig. 5). Paint about half of the unprinted side of the oilcloth with red enamel. After the paint dries place a strip of white adhesive tape across (square to the edge of the band) the ragged line where the red paint flowed unevenly. This serves as the index when comparing temperatures from scale to scale. (Fig 5 and 6.)

Put the dowels inside the band as indicated in Fig. 5. Place wood glue on the ends of the dowels and bend the chart along the length so the dowels can be inserted in the holes. Bend the chart back and allow the glue to dry. The band can now be moved to indicate equivalent temperatures.

Biology; General Science

Comparing Methods of Artificial Respiration

ROBERT C. McCAFFERTY, Central High School
Wadsworth, Ohio

The advantages of back pressure-arm lift artificial respiration may be made clear to a class by recording breathing of the subject on a revolving drum, as is illustrated in Figs. 1a and 1b. The equipment that is used consists of a medium-spring Kymograph with an aluminum drum, pneumograph, Marey tambour, short paper for spring Kymograph, and a small kerosene smoker lamp. These items may be obtained from the Harvard Apparatus Company, Dover, Massachusetts.

Figure 2 shows how the results of two methods of artificial respiration may be compared.

FIGURE 1a. Biology students apply back pressure-arm lift artificial respiration and show the results on a revolving drum.

FIGURE 1b. You will note that the pneumograph is placed over the back of the subject while recording the breathing of the subject.

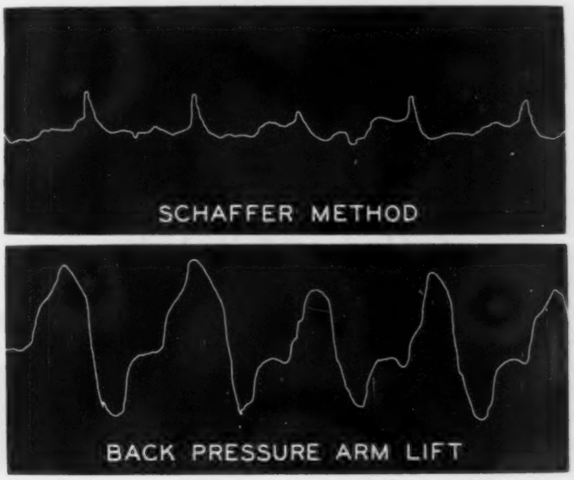


FIGURE 2. Kymograph records show the effectiveness of the back pressure-arm lift artificial respiration compared with the Schaffer method. Photos by Oliver Cooper.

NSTA Activities

Next Conference - Berkeley

After the Lake Texoma conference Oct. 14-17, next is NSTA's winter conference held annually in conjunction with the meeting of the American Association for the Advancement of Science. The meeting this year will be held on the campus of the University of California, Berkeley, December 27-29.

The program offers a rich bill of fare for teachers of science at all grade levels—elementary, high school, and collegiate—and in all fields of science. The usual attractions of the huge AAAS meeting will provide added opportunities to see exhibits, hear some of the nation's foremost scientists, and view many new films in science.

NSTA's program on Monday the 27th opens with a session devoted to "The Role of Science in the Education of Youth." A key speaker followed by three "Town Meetings" stratified by grade level will consume the morning. Reports on "This Is Your NSTA" will feature the luncheon hour, while in the afternoon there will be a series of concurrent sessions on "Keeping Up To Date With Science." The day's activities will close with a social-mixer with the evening free for "on the town" excursions.

Tuesday will be given over to consideration of "Some Problems That Science Teachers Must Solve." This subject will be treated by a key speaker followed by several work-discussion groups meeting during the morning and throughout the afternoon. The evening of the 28th is open for attendance at the AAAS Presidential address.

The morning session on Wednesday the 29th is sponsored jointly by NSTA, NARST, Section Q (Education) of the AAAS, and the Cooperative Committee of the AAAS. Designed to review "Recent Research in Science Education and What It Means to Teachers," the session will present brief addresses and discussions of the topic.

The meeting will conclude Wednesday afternoon with another run of the ever-popular "Here's How I Do It" presentations. Six concurrent groups of "this is my best" type demonstrations will present teaching ideas for grades K-2, 3-6, 7-9, and in biology, chemistry, and physics.

Other items that will appeal to teachers are the annual AAAS Junior Scientists Assembly, the meetings of NABT and ANSS, and the highly significant program planned and conducted by the Cooperative Committee on the Teaching of Science and Mathematics. The Committee's program will deal with action ideas for (a) increased salaries to enhance the financial attractiveness of teaching in general and science teaching in particular; (b) improved prestige for high school science teachers; (c) improved preparation of science teachers; and (d) increased opportunities for in-service training of science teachers.

The Berkeley meeting is by no means restricted to the western region or to NSTA members. All science teachers are invited and urged to attend if at all possible. NSTA's program has been planned by an "Action Committee" of 21 persons close enough to the Bay Area to meet together to discuss and execute the multitudinous details. This committee has been assisted by an "Advisory Committee" of 24 persons throughout the western states—NSTA officials, state directors, and representatives from NSTA's affiliated groups in the region. NSTA President-elect, Dr. Robert Stollberg, has served as general chairman.

Unusually attractive rates on rooms and meals hold for this conference. Meals will be available at campus cafeterias at typical student rates. Dormitory facilities—two persons to a room—can be obtained on campus at $2.00 for the first night, $1.00 a night thereafter. *Make reservations early.* Write to: AAAS Housing Bureau, 2223 Fulton Street, Berkeley, California. Give time of arrival and departure, names of others who will share room, and other pertinent information.

It's Not Too Early-

To plan on attending the 1955 NSTA Convention in Cincinnati

Committee planning for the Cincinnati Convention has been under way for more than six months. A theme has been chosen—"More Realistic Science Teaching—Toward What Ends?"—and already several key speakers have been secured. Program plans will follow closely those of NSTA's first two conventions. There will be symposia, panels, "clinics," and "Here's How I Do It" sessions. Twelve to fifteen work-discussion groups will provide opportunity for every attendant to be an active participant. Special sessions for elementary science, as well as high school and college, will be provided.

Educational and commercial exhibits of science teaching aids and materials will again be a feature of the

convention. Showings of science teaching films will be offered in several continuous sessions this year, rather than confined to a few early morning or late afternoon hours.

A new program feature will be sessions devoted to reviews of recent research in science and the strengthening of teaching through the use of such research results. There will also be heavy emphasis on the use of science demonstrations in teaching at elementary and high school levels.

The Hotel Netherland Plaza provides excellent facilities for such a convention, and the local "housekeeping" committees are planning on handling some 1200 science teachers during the period March 24-26, 1954.

Here are several thing which you can do—now—to help assure the success of the convention. (1) Begin taking steps to get released time for yourself and many of your colleagues to attend. (2) Talk with your principal and superintendent and urge that your school system be represented at the convention by at least one teacher each from elementary, junior high, and senior high levels. (3) Watch for the listing of the work-discussion groups which will appear in an early Packet. This will enable you to volunteer as a participant in one of the groups; and if a letter of invitation from us will help you get time and perhaps expense money to attend, let us know and we'll gladly write in your behalf. (4) Let us know if you would like to be scheduled for a "Here's How I Do It" presentation. Give full details when writing. Ordinarily these presentations must be limited to 15-20 minutes and will be strictly timed. Sessions are planned for elementary science, junior high school general science, biology, and chemistry and physics combined.

The general planning committee for the convention is comprised of E. Louise Lyons, *chairman,* Steubenville High School, Steubenville, Ohio; Bonnie Howard, Elementary Supervisor, Louisville, Kentucky; Brother I. Leo, St. Mary's College, Winona, Minnesota; Gladys V. Benner, Special Assistant in Science, Philadelphia, Pennsylvania; William F. Goins, Jr., Brooklyn College, New York City; S. Ralph Powers, Emeritus Professor, Teachers College, Columbia University, New York City; Kenneth E. Vordenberg, Supervisor of Science, Cincinnati, Ohio; NSTA President Walter S. Lapp, Overbrook High School, Philadelphia, Pennsylvania; and NSTA Executive Secretary, Robert H. Carleton, Washington, D. C.

Another NSTA Service

The Educational Testing Service of Princeton, New Jersey, has announced two new tests in the National Teacher Examination series, one entitled *Biology and General Science,* and the other *Chemistry, Physics, and General Science.* It is believed that the inclusion of general science questions in both tests will make these examinations appropriate for evaluating the knowledge of most prospective teachers.

The tests were prepared under the general direction of a committee appointed by ETS from a panel nominated by the National Science Teachers Association. Members of the committee were Mrs. M. Gordon Brown, Science Coordinator, Atlanta, Georgia, Public Schools; Dr. Charlotte L. Grant, Biology Teacher and Guidance Officer, Oak Park and River Forest, Illinois, High School; Mr. Keith C. Johnson, Head, Department of Science, District of Columbia Public Schools; Dr. John S. Richardson, Professor of Education, Ohio State University, Columbus; and Mr. Henry A. Shannon, Adviser, Science and Mathematics, North Carolina State Department of Public Instruction.

A survey conducted last spring showed that five State Departments of Education, 149 city and county school systems, and 304 teacher education institutions will be cooperating in the 1955 NTE program. NSTA is glad to have been of some assistance in the development of the science teacher tests for this program.

Life Members

NSTA's Roster of Life Members continues to grow. Since January 22, 1954, 23 additional names have been added to the list as published in the February 1954 issue of TST. This brings our total to 110 as of September 15. The Board of Directors gave recognition to the contributions of our life members by recommending that one-half of the annual income from life memberships be used to set up a general endowment fund to which other funds, grants, and gifts may be added from time to time. The use of the endowment fund will be determined by the Board. We present to our readers the names of the following new life members who have chosen this way to give their support to our professional organization.

Alber, Charles W., Muncie, Indiana
Allen, Hugh, Jr., Upper Montclair, New Jersey
Binger, Robert D., Lanham, Maryland
Chattalas, Angelos Mike, Larnaca, Cyprus
Daspit, Robert A., St. Martinville, Louisiana
Duncan, J. Bruce, Oakland, California
Gentry, Adrian N., San Diego, California
Gladding, Allen S., Oakland, California
Gowen, Forrest R., Cheshire, Connecticut
Heck, Alexander W., Lexington, Kentucky
Lyons, E. Louise, Steubenville, Ohio
Marean, John H., Reno, Nevada
Matthews, Charles C., Omaha, Nebraska
McCullough, Allan H., Baker, Oregon
Muckle, Roy Thomas, Jr., N. Charleroi, Pennsylvania
Nelson, Ray M., Danville, Indiana
Parker, Grady, College Station, Texas
Perkins, Philip, Irvington, New Jersey
Poritzky, Harold, Yorktown Heights, New York
Roberts, Eugene, San Francisco, California
Rosoff, Rose, Philadelphia, Pennsylvania
Smith, Jobe Vernon, Warwick, Virginia
Templeton, Hugh, Albany, New York

FSA Activities

The FSAF is soon to have another birthday. How is this new child of the NSTA making out? Is he getting the right kind of food and care? Is he growing? Can he carry his share of the NSTA load? What can he do?

Let's answer the last question first. By now we know that the FSAF can:

1) Conduct the American Society for Metals' Awards Programs so more and more students and teachers can reap their benefits.

2) Produce pamphlet services, for example, *Encouraging Future Scientists: Materials and Services Available in 1954-55* and *Student Projects.*

3) Promote ideas of value to the profession, for example, "Let's Help America's Science Teachers Find Science-Related Summer Jobs" and *Careers in Science Teaching.*

4) Sponsor research in the teaching of science. The thirty-two teachers in the Crown Zellerbach West Coast Science Teachers Summer Conference found eighteen ways to improve laboratory work. Basing their suggestions on thirty-two interviews in laboratories, they produced twenty-seven new laboratory exercises.

Now how about the first question? Industry gave the FSAF about $35,000 in 1954. Many people gave expert counsel and advice.

What did you do? Did you or your students enter the Awards Programs? Did you help other teachers use the pamphlet services? Have you turned in any good research topics for summer conferences? Have you told us whether or not it was a good idea to encourage industry to provide summer jobs for science teachers? To how many bright students will you give *Careers in Science Teaching?*

Although industry gave 50% more money in 1954 than in 1953, fundamentally the health of the FSAF is strictly in the hands of the science teachers in America.

The Future Farmers of America Foundation serves more than 90% of our agriculture teachers and industry supports them accordingly.* The Junior Achievement movement has sparked so much interest in business that industry backs their program with hundreds of thousands of dollars. And yet industry knows they have an enormous stake in science teaching.

If we can tell industry what teachers will use to attract and hold capable science students, quite likely industry will provide the money.

We hope the new child is helping out with the total NSTA program. How much more he does depends entirely upon how much more you give him the strength to do. With your help, he may turn out to be a rather husky and energetic lad.

Summer Jobs for Science Teachers?

Do you want the FSAF to continue asking industry to hire science teachers through the summer? If you do, help us find men and women who can and will answer the following questions:

1) Where did you work in 1954 and what did you do?

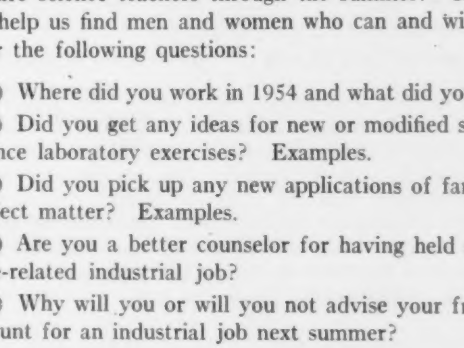
2) Did you get any ideas for new or modified school science laboratory exercises? Examples.

3) Did you pick up any new applications of familiar subject matter? Examples.

4) Are you a better counselor for having held a science-related industrial job?

5) Why will you or will you not advise your friends to hunt for an industrial job next summer?

* It is noteworthy that student interest in vocational agriculture has grown so great that teachers can now select those students who show outstanding promise of success.



Book Reviews

Physical Geology. L. Don Leet and Sheldon Judson. 466 pp. $6.75. Prentice-Hall, Inc. New York. 1954.

This book is recommended for readers who have had no previous work in geology or in science at the college level. It may be used to supply that need or it may be used for a foundation on which to further continue work in this field. Even to a person who has been introduced to the subject of geology, this is an informative book. It is unique in that it introduces the subject of geology through physics and chemistry before discussing igneous rocks, weathering and soils, sedimentary rocks, mass movement of surface material, running water, underground water, glaciation, work of the wind, the oceans, rock mobility and mountain-building, earthquakes and the earth's interior, igneous activity and metamorphism, the earth's age and place in the universe, and mineral deposits and fossil fuels.

There are many interesting and informative pictures and diagrams. There is a glossary in the back of the book, and the appendices include a chart on electronic configuration of the elements, and a listing of the elements, powers of ten, some distances and sizes expressed in powers of ten, geologic divisions of time, and minerals arranged according to specific gravity and hardness. Also included are brief descriptions of minerals and topographic maps and an index.

Eleanor L. O. Haslem
Pequannock Valley School
Pequannock Township, New Jersey

Through the Magnifying Glass. Julius Schwartz. Illustrated by Jeanne Bendick. 142 pp. $2.50. Whittlesey House, McGraw-Hill Book Company, Inc. New York. 1954.

Mr. Schwartz's *Through the Magnifying Glass* is designed to help youngsters from ten years old and up to discover and understand the world of little things around them. Since a lens is such an easy thing for youngsters to obain, and since Mr. Schwartz picks common objects to examine, his book marks a valuable contribution to the elementary science field.

Crystals, skin, onion cells, root hairs, pollen and insects are only a few of the objects that are discussed in the book. The author tries to explain the "whys" behind some of his explorations as well as to describe how to look and what to look at. Generally, he remains well within the comprehension of youngsters so that any child reading the book will be able to understand and do most of the activities.

The illustrations in black and white on almost every page help to make the book attractive, appealing and informative.

J. Myron Atkin
Public Schools
Great Neck, New York

New Senior Science. George L. Bush and Will S. Thompson. 642 pp. $4.28. American Book Company. New York. 1954.

New Senior Science is a well written and well illustrated text for pupils whose formal education will end in high school. It integrates the major concepts of the physical sciences in a practical and functional setting. Yet, it takes note of social implications, the scientific method, and other worthy science objectives.

The readability, interest, and up-to-dateness of this book are first rate. Sea-going oil drills, ammonia fertilizers, transistors, rockets, and atomic energy engines are treated very meaningfully for adolescents.

Some of the units designed to meet "adjustment-to-living" needs are Selecting and Operating a Home and Problems of Safe Living. The use of soil, engines, chemicals, water, and food are treated in an informative style.

Learning and teaching aids of a high quality are provided in end-of-unit summaries, lists of activities, group research projects, and reading lists. The double column format makes reading easier and faster. There is a lavish array of striking photographs which averages about one per page. This is a book which pupils and teachers will like very much.

William B. Reiner
Bureau of Research
Board of Education
New York City

Electronics for Everyone. Monroe Upton. 353 pp. $6.00. The Devin-Adair Company. New York. 1954.

This book comes nearer being for "everyone" than most of its type. It fills the gap between the technical or how-to-do-it books and those which give only a historical summary.

The first third of the book is given to a presentation of background principles: electrons, current flow, electromagnetism, generation and measurement of direct and alternating currents, and resonant circuits. Then follow the practical applications, from the early experiments of Hertz and Marconi to the present-day navigational aids and color television. At the appropriate places tribute is paid to the persons who had most to do with the development of the science. There are thumbnail biographies of more than 50 experimenters and inventors.

The style is informal with a little dry humor here and there; it is definitely not a textbook. Over a hundred sketches, a comprehensive index, and a list of suggested readings add to the usefulness of the book. The mathematics does not go beyond elementary algebra.

The author has a varied career in radio and electronics extending back 40 years: radio "ham," sea-going operator, broadcast engineer, and radar technician. Added to this is experience in writing and producing for radio.

The book has a definite place in a high school physics library as a reference to help students realize that hundreds of scientists have contributed to the vast field of electronics, and that the end is not yet in sight.

M. M. Hasse
Central High School
Aberdeen, South Dakota

GRAPHIC SURVEY OF SCIENCE. William Lemkin. 377 pp. $1.20, paper bound. ($2.20, cloth bound.) Oxford Book Company. New York. 1954.

This book for ninth-year secondary school students is a survey of sciences found in the usual ninth year courses throughout the country. It is divided into four major units: Matter, Energy, The Earth, and Life. Included in these four units are well presented sections dealing with air, water, matter, machines, electricity, heat, light, sound. Weather, climate, earth science, living things, human body, micro-organisms and disease complete the topics. Dr. Lemkin writes in a very interesting and informative way. He has many years of experience with this age group as an instructor and knows how to reach them.

The format of the book is good. Many black and white drawings to illustrate principles are included; also some splendid multi-colored charts. Simple experiments which can be performed by the student are included; also, at the end of each chapter thought provoking questions are used as a review device. The book is essentially a concise text and well worth looking into as a book for the use of students.

In my opinion the subject matter is well covered, understandable, accurate, and geared to facilitate easier learning.

RUBIN R. MILLER
Central High School of Needle Trades
New York City

HONEYBEE. Mary Adrian. 51 pp. $2.00. Holiday House. New York. 1952.

MONARCH BUTTERFLY. Marion W. Marcher. 45 pp. $2.00. Holiday House. New York. 1954.

Both of these information-packed little books take a biographical story line in describing the life cycles of "Monarch Butterfly" and "Honeybee." The personification of the main characters is ably done without the usual misconstructions of the Peter Rabbit school of writing. The emphasis throughout is purely that of nature study. Each insect is closely followed through its life cycle for the seven to ten year old reader. Broad conceptual or ecological emphases have therefore not been among the objectives of these books. Barbara Latham's clear, color illustrations follow along with the points of the text on almost every page.

"Honeybee" is vignetted in her life cycle from egg to adult, and into her adult roles as nurse bee, household worker, and forager. The marvelous abilities of bees to sense direction, distance, amount and kind of food are simply described. Swarming, royal jelly, making of honey, structure of bees, enemies, and hive life are among the many other topics.

"Monarch Butterfly" is similarly followed from her migration north in the springtime through feeding, egg-laying and death. "Monarch" reappears then as "Caterpillar," whose metamorphosis into a "Monarch" the second, is slowly and clearly developed in pictures and text. An excellent last page tells the reader how to raise a Monarch butterfly from egg or caterpillar.

SEYMOUR TRIEGER
New Lincoln School
New York City

THE ZOO COMES TO YOU. Captain Burr W. Leyson and Ruth Manecke. 88 pp. $2.95. E. P. Dutton and Company, Inc. New York. 1954.

Here is a book which presents twenty-one animals common to most zoos. It includes the ever popular "Bambi, the Baby Deer," "Petunia, the Skunk," and "Blacky, the Crow," as well as the less discussed "Cocky, the Cockatoo," "Winky, the Baby Llama," and "Armadillo, the Digger." A separate story is written about each animal giving accurate information in an interesting fashion. All children who have any interest in animals will enjoy reading this book about the characteristics, habits, and care of these animals. Each story is illustrated with excellent photographs of the animals.

The book will be particularly enjoyed by children in the nine-to-twelve age group. Elementary science teachers will also want to use this book for reference work in the classroom. It may also be read to younger children who will enjoy knowing more about the animals of the zoo.

FLORENCE E. LEARZAF
John Morrow School
Pittsburgh, Pennsylvania

MICROBES AND YOU. Stanley E. Wedberg. 439 pp. $5.00. The Macmillan Company. New York. 1954.

Microbes and You is for college or university students who have little or no background in science, yet the content presents practical scientific material in a manner which would interest even the student with several years of science to his credit. The author is a recognized expert in his field of bacteriology and a member of the staff of the University of Connecticut.

The interest capturing introduction is followed by a brief but concise history of microbiology. The method used of supplementing scientific facts with practical everyday illustrations tends to increase the value of the book.

The variability of the material allows the instructor to plan for practical and scientific experiments. The book is concluded with a good bibliography for more extensive research as well as an adequate index. Even though the book is smaller in size than the average college text, the page format is very readable, which also adds to the value of this book.

CHARLOTTE BABCOCK
Conqueror's College
Portland, Oregon

MODERN CHEMISTRY. Charles E. Dull, William O. Brooks, H. Clarke Metcalfe. 587 pp. $3.88. Henry Holt and Company. New York. 1954.

This is a revised and re-written edition of a high school chemistry textbook long in common use. The authors have done the job with the advances of chemistry and the problems of the teacher in mind.

The book is organized along conventional lines. It consists of sixteen units, including units on Chemistry in a Modern World, Oxygen and Hydrogen, The Organization of Chemistry, as well as units on such topics as Nuclear Fission. Each chapter begins with a list of vocabulary and ends with a summary, questions, problems, and list of suggested activities. The authors have included two groups of questions at the end of each unit for the rapid learner and have starred certain portions of the text for their attention.

The illustrations and the manner of printing are particularly pleasing. The text reads easily and logically. There is a useful appendix of tables, common names and formulae.

IRVING KAMIL
Manhatten High School of Aviation Trades
New York City

Clip'n MAIL

These coupons announce the availability of free and low-cost teaching aids for science. Business-sponsored items have been reviewed by the NSTA Evaluation Committee and approved for distribution by the Association. To procure copies of desired items, fill out and clip the corresponding coupons and mail these, together with any remittance required, to the NSTA Executive Secretary, 1201 Sixteenth Street, N.W., Washington 6. Watch these columns for additional offerings in future issues of *The Science Teacher*. (Print or type coupons.)

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THE VEST POCKET CHART OF THE ATOMS. *W. M. Welch Manufacturing Company.* A small chart which features a useful black and white picture of the chart on one side and a listing of the elements in alphabetical order with essential chemical data on the other. Sufficient quantities for distribution to all students in a class will be sent to the teacher on request. Single copies will be sent to individuals if a stamped, return envelope is included with the request. *Free*

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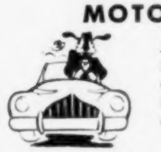

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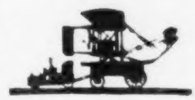

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Kenneth L. Holst Audio-Visual Education Service
1399 N. Lake Ave., Pasadena 6
McCurry Foto Company
Eighth and Eye Sts., Sacramento 14
Knight's Library of A-V Aids & Equipment
527 University, San Diego 3

CANADA
Sovereign Film Distributors Ltd.
277 Victoria Street, Toronto

CONNECTICUT
Inter Church Audio-Visuals, Inc.
15 May Street, Hartford 5

DISTRICT OF COLUMBIA
"The" Film Center
915 12th St., N.W., Washington

FLORIDA
Ideal Pictures Company
1331 N. Miami Ave., Miami

GEORGIA
Calhoun Company
235 Ponce de Leon, N.E., Atlanta

ILLINOIS
Illini Audio-Visual Education Service
221 Main Street, Peoria

INDIANA
Indiana Visual Aids Company, Inc.
726 N. Illinois Street, Indianapolis
Dennis Film Bureau
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Lewis Film Service
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Delta Visual Service, Inc.
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Cinema, Incorporated
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Ideal Pictures
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Engleman Visual Education Service
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OHIO
Manse Film Library
2514 Clifton Ave., Cincinnati 19
Academy Film Service, Inc.
2110 Payne Avenue, Cleveland 14
Twyman Films, Inc.
400 West 1st Street, Dayton 1
Ideal Pictures
23 N. Mulberry, Mansfield
Cousino Visual Education Service
2325 Madison Avenue, Toledo 2

OKLAHOMA
Vaseco, Inc.
2301 Classen Blvd., Oklahoma City 6

OREGON
Ideal Pictures
915 S. W. Tenth St., Portland 5

PENNSYLVANIA
Christian Youth Cinema, Inc.
2128 Jenkintown Rd. (Box 201), Glenside
J. P. Lilley & Son
928 N. Third Street, Harrisburg
Ideal Pictures
1729 Sansom Street, Philadelphia 3
Karel Sound Film Library
214 3rd Avenue, Pittsburgh 22

SOUTH DAKOTA
Taylor Films
79 Third Street, S. E., Huron

TEXAS
Ideal Pictures
2010 North Lamar, Dallas
Miller's Visual Aids, Inc.
519 Pennsylvania Ave., Fort Worth
Community Sound Film Service
2610 Fannin Street, Houston 2

UTAH
Deseret Book Company
1400 Indiana Avenue, Salt Lake City

VIRGINIA
Tidewater Audio-Visual Center
617 W. 35th Street, Norfolk 8

WASHINGTON
Audio-Visual Center, Inc.
1205-1207 N. 45th St., Seattle 3
Rarig Motion Picture Company
5514 University Way, Seattle 5

WISCONSIN
Roa's Films
840 N. Plankinton Ave., Milwaukee 3

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